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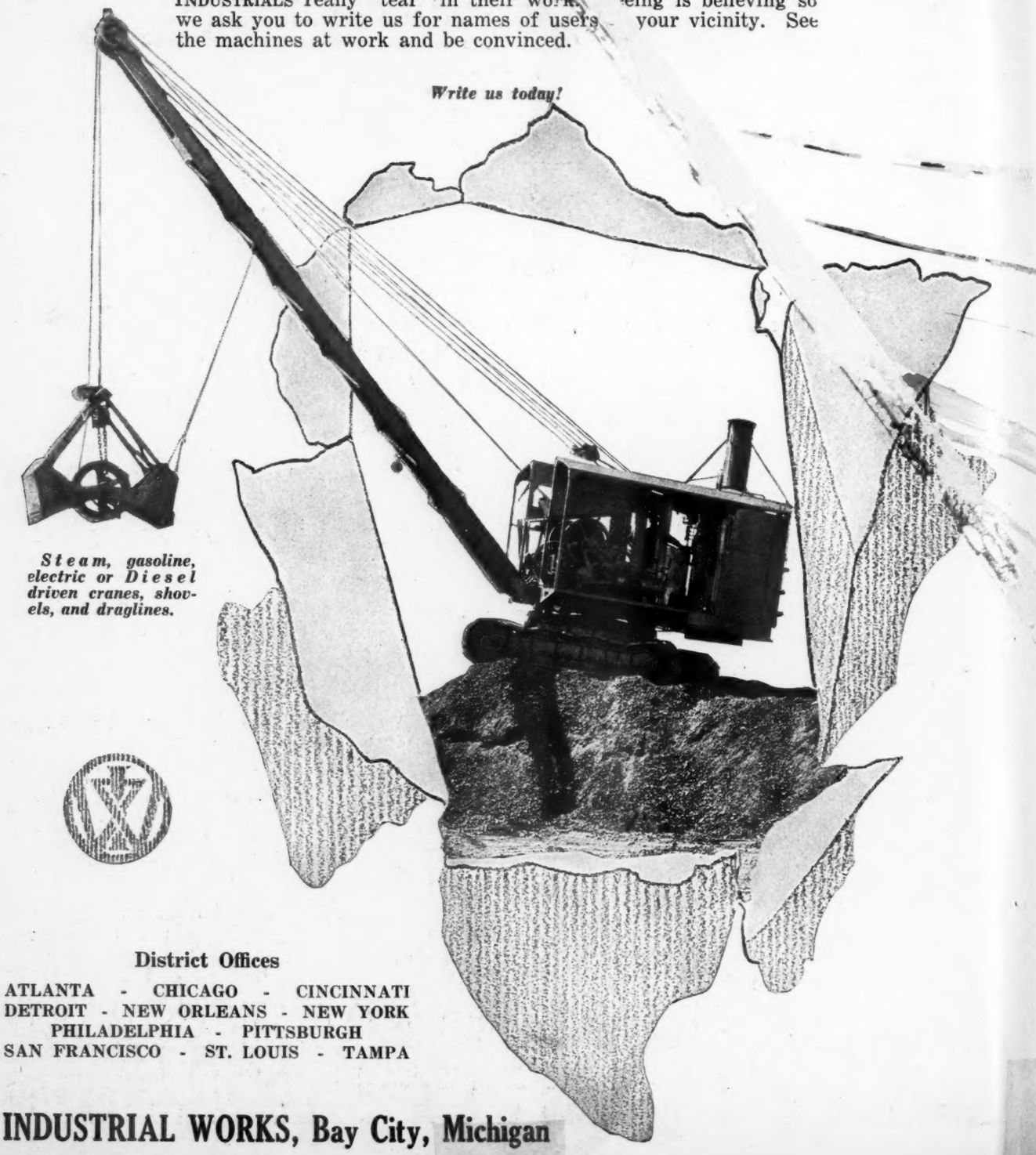

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Pit and Quarry

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Vol. 13 CHICAGO, ILL., DECEMBER 22, 1926 No. 6

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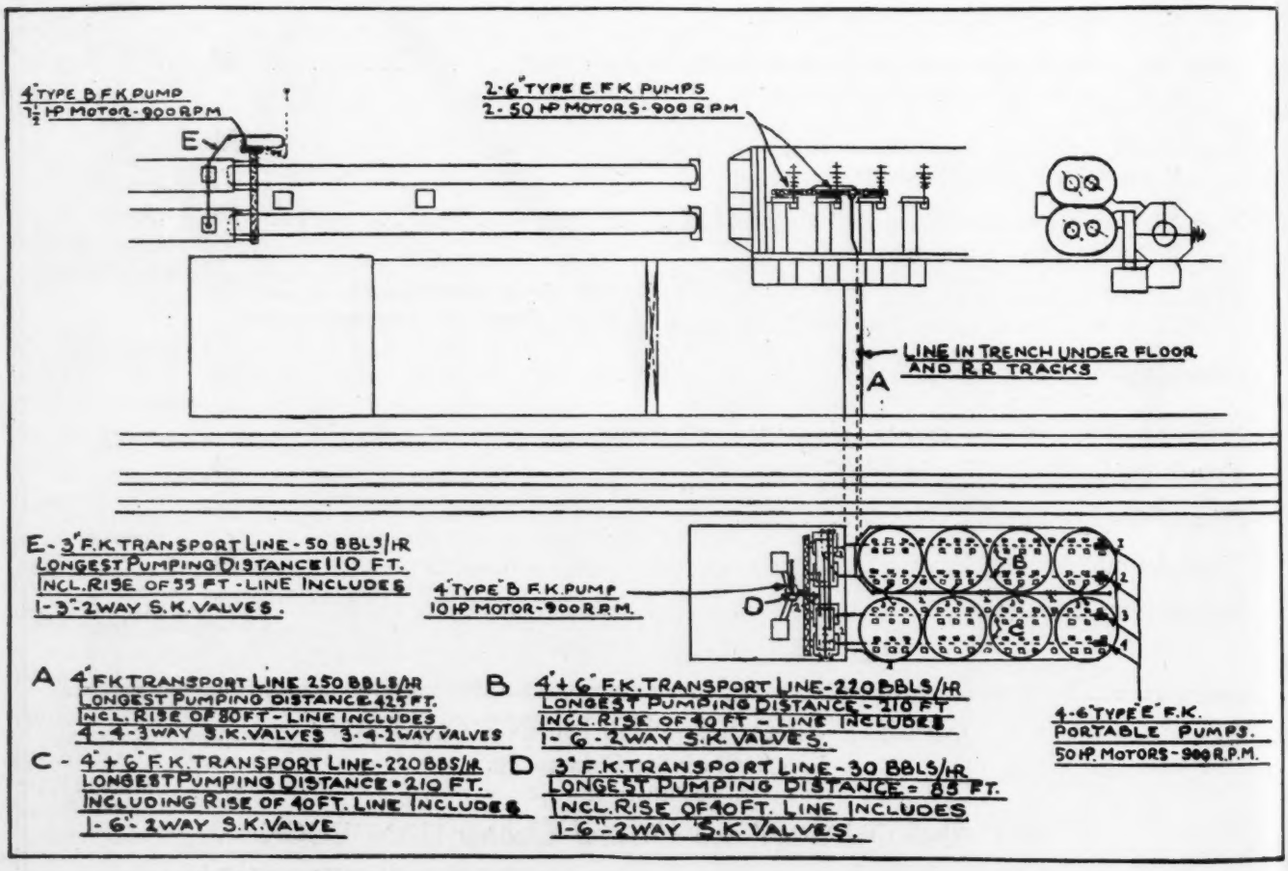


FULLER COMPANY
Catasauqua, Penna., U. S. A.

Pit and Quarry

Vol. 13 CHICAGO, ILL., DECEMBER 22, 1926 No. 6

PROGRESSIVE MOVEMENT IN NEW ENGLAND

THE Second New England Conference held at Hartford, Connecticut, on November 18 and 19 for the purpose of stimulating the industrial activity and prosperity of the six New England states was a great success. To one who has attended that enthusiastic nad determined gathering of leaders of the farming, manufacturing, commercial, transportation and civic activities of this section, the idea of any permanent decline in New England seems preposterous. Any community which is capable of searching itself with such honest candor and so enthusiastically applauding and supporting suggestions for its good is bound to continue its great past.

This movement is of as much importance to the non-metallic mineral industry as to any other. The industry holds an important place in New England, and its growth and prosperity are inseparable from the general prosperity of that region. All industries are now so much dependent on each other that hard times in one is sure to make itself felt in several others, and a general decline in prosperity and growth cannot be expected to leave any untouched spots. Just how this comes to pass is made evident when we consider that a lime producer in Addison County, Vermont, ships the largest part of his product to paper mills in New Hampshire and Maine, and one of the important customers of a lime plant in western Massachusetts is a sand-lime brick and tile maker near Hartford, Connecticut, who has large sand and gravel operations.

The object of these conferences, which have as a permanent body the New England Council with headquarters in Boston, is to promote co-operation and progressive development in all lines of business in all parts of this industrial "community," as it has been aptly termed.

It has been realized that the six New England states form an industrial unit and that they have suffered from too much individualism which it is now proposed to replace with the most complete co-operation practicable. To this end the Council has formed a number of committees whose membership is made up of representatives from each state. Among the most important is the Committee on Research which, among other things, has already made experimental marketing surveys in three important industries and has held more than fifty conferences with groups and individuals to discuss industrial problems out of which have appeared the need of emancipation from traditional ways of doing business, of more attention to service, of keeping up with the rapid changes in demand, and of assuming more leadership.

The Power Committee is considering the best means of the conservation of the rather extensive water-power resources of the whole region and the creation of a completely inter-connected power system. The transmission of power from one state to another has brought up some delicate matters relating to inter-state traffic which, in the absence of Federal regulations, are being handled by joint agreements in a very enlightened way which apparently makes Federal interference unnecessary. There are many other committees on such subjects as Recreational Resources, Transportation, and Publicity, which are functioning on the basis of a consideration of the problems of New England as a whole and its relation to the rest of the country.

The climax of the conference was a dinner given by the Governor of Connecticut, at which 1,200 men and women were present and which was followed by a meeting at which Governor Trumbull of Connecticut and Governor Brewster of Maine spoke. A paper prepared by Mr. Owen D. Young, Chairman of the Board of the General Electric Company, was read (Mr. Young could not be present on account of illness), in which he had a great deal to say about co-operation. Among other things, this statesmanlike captain of industry said: "Artificial barriers to economic co-operation are the curse of the world today. I mean those barriers which represent the vested habits of a bygone age and serve no useful purpose now. Vested habits are difficult to down. So are barriers based on them. . . . It will be necessary for us to deal with them in so far as barriers exist, either political or social, which prevent the maximum development and use of the resources of this country within her borders. It will be necessary for New England to deal with them in so far as useless barriers, either social or political, prevent her maximum economic development."

PRICE OR PROFITS?

WE HAVE been hearing and reading much of late about cutting and profits. It is to be hoped that the subject does not become trite since there is a great need for fuller appreciation of the value of profits and the dangers of price cutting. There can be nothing of greater importance to manufacturers, wholesalers, jobbers or retailers, than the obtainment of a fair return for every dollar invested. There is no substitute for profit. Either it must be had or failure endured.

John A. Wild, F.C.W.A., recently wrote an impressive and scholarly article for an English technical magazine on this subject. So fundamentally sound were his arguments that we quote a few of them here:

"It is both sound business and the duty of the manufacturer to give value for the money of his customer. Not only is this a duty to the consumer, but it is a duty to himself and his business, for if his productions are consistently priced at a higher figure than their fair value his sales will decrease and his business ultimately fail. If, on the other hand, he prices his goods at less than their fair market value he will not be able to meet his commitments, for the outgoing of cash will be greater than the income. . . . .

In the buying and selling of any commodity the price obtained depends upon the amount of competition in goods of similar quality, in the amount of demand and in the availability of supplies. If there is a scarcity, then the buyer will be ready to pay more; if there be a surplus he will have a wider range of choice and will pay less. Wherever there is a surplus there is sure to be a seller, who, through ignorance or financial embarrassment will realize his goods at far below their actual cost or production, and the natural result is that the market value of other manufacturer's goods is brought down."

Manufacturing, in the last analysis, is only a form of merchanting. Like the problems of the retailer or the wholesaler, the manufacturer's work is merely a matter of buying and selling, the sole difference being that the material leaves the manufacturer in a different form to that in which it was purchased or produced in its raw state. The reason for the existing prevalence of low profits and high investment risk in manufacturing lies in the fact that there is no straightforward, predetermined method whereby all manufacturers may accurately ascertain the purchase price of the finished product. It is a difficult matter to determine the actual production cost of a bag of cement, when the materials entering into the manufacture of that bag of cement are bought in little bits—bits of raw material (frequently in long variety)—bits of labor—bits of rent—bits of light, heat and power—and bits of a thousand other items. In fact no two plants will produce the same product at the same cost, for no two plants are identical in their equipment, either managerial or mechanical. Because of the greatly varied factors that enter into the manufacture of any product, selling value, in reality, has no definite or exact relation to the cost of the goods. Profit, therefore, is an essential.

ANOTHER REASON WHY PROSPERITY IS AHEAD

ONE of the far-reaching but little recognized developments of American business today is the growing conservatism of the industrial executive. If one could travel throughout the United States and make intimate contact with influential men in every walk of life, and if that one knew conditions and men of twenty-five years ago, the traveler would be impressed with the deeply entrenched tendency among business men today to keep their feet on the ground.

The average business man of 1926 has gone through the war period with its necessary period of readjustment. This brief experience taught him more about conservative management and the necessity for adopting cautious policies and for feeling his way, than he could have learned in twenty years of normal activity. During pre-war days, industrialists were slowly but surely becoming less and less cautious in the matter of business policies and, with the establishment of what they thought would be a governmentally controlled Federal Reserve system, were getting into a speculative frame of mind. Such tendencies are but the natural concomitants of long-continued prosperity, and, expensive as it may have been, the war did much to save the American industrialist from himself and set him back on a conservative, more sound, foundation.

The long period of war suffering, more or less acute with every individual, has left its stamp on the minds and hearts of all men bearing responsibilities. Indeed, any man of sanity, experience and imagination who went through that period of over-seas strife, followed as it was by a period (for us equally long) of commercial strife—any man who went through that period and finally got his feet on the ground and himself and his business back to normalcy—had indelibly branded in his brain the wisdom of the policies of conservatism, the necessity for cautious action, the fallacy of over-optimism, the need for envisioning obstacles. The situation is purely psychological, it is true, but it is one of the far-reaching, deep-going factors that contributes to optimism when considering long range business.

THE 1926 MODEL CRUSHED STONE PLANT

By S. C. Hulse

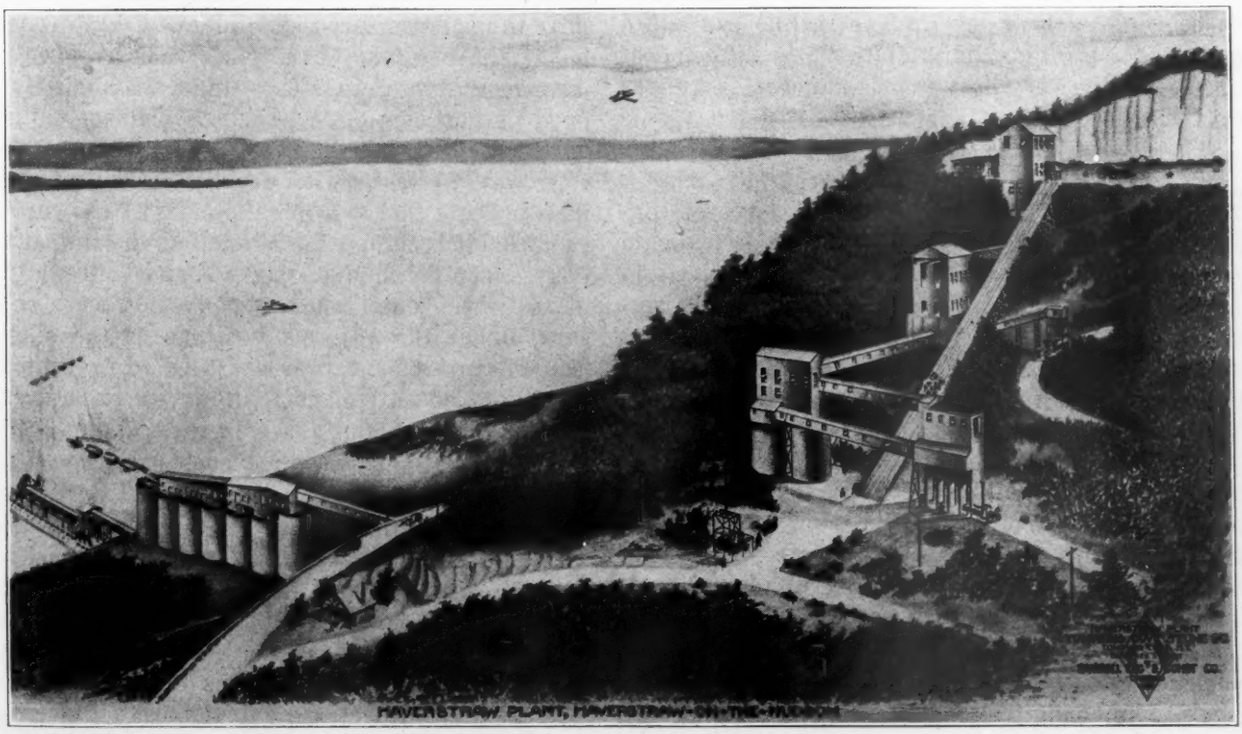
FOR seventy years The Tomkins Cove Stone Company has quarried and crushed limestone at Tomkins Cove on the west bank of the Hudson River thirty-five miles north of New York. The capacity of this plant is 5,000 cubic yards per day. During the past year the company has built and put in operation a new plant seven miles down the river, just south of Haverstraw, which will produce 2,500 cubic yards of trap rock daily. In developing this property the company has been mindful of other than merely utilitarian considerations. The quarry face is located on the back of the Palisades, out of sight of the river, and no effort has been spared to preserve natural scenic conditions. Also, much time and money have been expended to control and keep down the dust which is an inevitable accompaniment of crushing operations.

General Description

From the primary crusher to the loading boom on the wharf the distance is approximately 2,000 feet, and the difference of elevation is 400 feet. The plant is essentially "side-hill" throughout. The crushing is done in three buildings connected by horizontal conveyors, stepped down a slope from the quarry floor level to a flat 425 feet distant and 165 feet below. The compressor house-blacksmith shop building is located back of the primary crusher building at quarry floor level, and a garage for housing and maintaining the quarry trucks is nearby. Screens for scalping and for the removal of quarry top soil are located in the three crushing buildings. Alongside these buildings is a permanent incline of timber construction on concrete piers with a car capable of handling a thirty ton load. From the third and lowest of the crushing buildings the stone is taken on an 800 foot belt conveyor through a tunnel under a shoulder of the mountain behind which the quarry and crushing buildings are located, under the State Highway, over a bridge across the West Shore R. R. to the top of the first of seven silo storage bins. The live storage capacity of these seven bins and two bins in the third crushing building aggregate 11,000 cubic yards. On the tops of these silos is a continuous structure three hundred and fifty feet long housing a progressive system of screens which deposit each size of stone in its proper storage. Underneath the silos is a reclining tunnel and belt conveyor which takes the stone to a washing plant at the inshore end of the wharf and from here another conveyor carries it to the loading boom further out on the wharf. For the present most of the product will be shipped by barge.

Engineering and Construction

Reinforced concrete was generally mixed in the proportions of 1-2-4, and plain concrete 1-2½-5. Dragon and Lehigh cements were used equally on the work while the crushed stone came from the company's plant at Tomkins Cove. Reinforcing steel was of re-rolled bars. A small amount of Lumnite cement was used in the conduit under the



An Artist's Interpretation of the New Plant

State Highway where extra speed of construction was essential. Concreting was begun in December, 1925, and continued throughout the winter from two mixing plants, one each on the upper and lower parts of the job. Throughout the work frequent tests were made by the Robt. W. Hunt Company of materials and cylinders sent to their New York laboratories. The total yardage of concrete, mostly reinforced, was 5,000, and 232 tons of reinforcement were used. Structural steel amounted to 567 tons. Approximately 6,000 cubic yards each of rock and of dirt were excavated. There was no serious accident during construction.

The three crushing buildings are all on rock foundations, there being a very heavy cut under building number 1, and their lower parts are of reinforced concrete surmounted by steel frame structures sheathed in corrugated iron. Floors are all of reinforced concrete and subway grating was used for all stair treads. Ample room everywhere is characteristic of the entire plant design. Building number 1 has a short section of concrete tunnel in front to protect the outgoing conveyor from a heavy fill, the top of which affords a roadway for the trucks hauling quarry stone to the primary crusher. The two upper buildings are rectangular in shape and were poured in built up forms of lumber. The lower thirty feet of the lowest building consists of two adjacent silos and these were carried up together in slip forms of lumber. The permanent incline, equipped with a 40 h. p. Mundy electric hoist, was started at the beginning of construction and played a very important part in the handling of materials, and of the heavy machinery installed in the buildings. Two Marion type 37 shovels were taken up this incline, and assembled at the quarry floor level. The incline car has a positive drag-brake and in spite of the 42 per cent grade and the very heavy loads handled, there was no accident.

All tunnels and bridges for conveyors are nine feet wide and have at least 6 feet 6 inches of headroom. The first 200 feet of the long conveyor tunnel is designed to carry storage 70 feet deep should this be desired later. From the concrete section to the conduit under the highway is a rock section of tunnel floored with concrete 300 feet long and on a 22 per cent grade. This section was drifted through from the lower end which enabled the muck to be run out on cars by gravity and wasted over a slope between the highway and the tracks of the West Shore R. R. No trouble was had in this part of the work as it was through trap rock with ample overhead material and the section is remarkably dry for an unlined tunnel. The lower end of the rock section joins the conduit, 45 feet long under the highway, the conduit and the bridge across the railroad tracks being level. The conduit was built in open cut and was very heavily designed and constructed to meet the highway engineers' anticipations of possible future traffic loads.

All conveyor bridges are of steel of riveted construction throughout, and sheathed in corrugated iron. The walkways are of two-inch plank. The bridge from the highway conduit to the first of the storage silos, over the West Shore R. R. is 200 feet long and the main span of 120 feet is supported on heavy concrete piers and steel towers, one of which encloses the takeup of the 800 feet belt conveyor. The main span, across the railroad tracks, was cantilevered and joined in the center while supported by temporary timber towers outside of the tracks. The work was done without any interruption of traffic and without mishap.

There are two horizontal angles in the alignment of the plant, one of 65 degrees where the conveyor from building number 2 discharges into the top of building number 3, and the other of 16 degrees where the 800 foot conveyor discharges on top of the first silo. The storage silos and the tunnel underneath rest on clay and gravel foundations. While the general plans were being drawn this ground was thoroughly tested by means of a block of oak one foot square under a gradually applied load up to four tons. On both the clay and the gravel it was found that when the full load was reached there was a sudden settlement of one to one and a half inches after which no further settlement occurred. The slope of this part of the site necessitated that the tunnel and silos be on a 10 per cent grade which would have entailed heavy excavation and extensive silo foundation walls, with consequent delay and expense, had this part of the work been designed in the usual manner. It was determined therefore to locate the tunnel as near the surface as possible and still keep its roof below the bottoms of the silos, thus avoiding excessive dead storage. The tunnel was built in an open cut excavation by a small clamshell digger on caterpillars and the deepest part of the excavation was 20 feet. Due to the character of the material and cold weather the sides of the cut held remarkably well and the outside of the tunnel was poured against undisturbed ground. In the few places where small amounts of backfill were necessary, under the adjacent footings of the silos, a lean mixture of concrete was used to prevent any possibility of settlement of the latter structures.

The silos rest upon ring footings, half on each side of the tunnel, on level benches excavated as nearly below the surface as good ground was encountered. Both the ring footings and the walls were kept entirely independent of the tunnel and each silo sits astride it with ample clearance. The ring footings are seven feet wide and two feet thick, heavily reinforced with radial bars and at least three feet of backfill was put on top of all footings as a protection against frost. Disregarding wind stresses the maximum load on the foun-

dations is 2½ tons per square foot and there has not been the slightest evidence of settlement. The silo walls were carried up 8 inches thick by means of slip forms to an average height of 55 feet. The concrete decks on top of the silos carry heavy loads of revolving or vibrating screens and each deck with its superimposed steel frame structure is supported by two composite girders of a design worked out by the contractor. The floor on which the deck was poured and which was built as an intregal part of the slip form, contained two troughs which formed the lower parts of the girders. When the top was reached, built up steel girders were erected in these troughs, their ends resting on the now hardened silo walls, and the forms were in turn fastened to and supported by the steel girders thus obviating any shoring or further support of the girder and deck forms. The girders were heavily enclosed in reinforced concrete, the whole being so proportioned as to deflect together under load and there is a marked absence of vibration of the silo decks when the screens are running. The silos are 35 feet inside diameter, are spaced 56 feet center to center and the space between silos is available for overflow storage. From the lower end of the tunnel under the silos a conveyor bridge 135 feet long crosses a public road and joins the upper story of the washing plant at the inner end of the wharf. The wharf is 365 feet long by 20 feet wide and is of reinforced concrete on piles cut off just above low water. The tide range here is about four feet and the top of the wharf is three feet above mean high water.

In the fall of 1925 and before the wharf was built a basin approximately 300 feet long and 150 feet wide was dredged at the inshore end of a channel 100 feet wide and running straight out into the river, 1,700 feet to deep water. Both basin and channel were cut to a 12 foot depth at low water and some 88,000 cubic yards of material were removed. This work was done with a dipper dredge by Jno. P. Randerson of Albany, on a separate contract. A very gratifying phase of the entire work has been the manner in which all closures were made without difficulty, in spite of the very considerable length of the plant and the differences of elevation covered.

Equipment and Operation

The power throughout the entire plant is electrical and about 2,000 connected h. p. is used. Current is delivered by the Rockland Light & Power Company at 33,000 volts, to a sub-station of three Allis-Chalmers type H, 6,500 Kv-a, 33,000-2,300/4,000 volt Y, single phase, 60 cycle outdoor type transformers. From this station the current is distributed, part of it through transformers to 440 volts, and to 220 volts for the lighting system. The interior of the whole plant is generously lighted with flood lights and incandescent lamps. A signal system enables any of the operating force to warn instantly the primary crusher in case of trouble, thus stopping the inflow of stone.

There are four synchronous motors in the plant, two of 225 h. p. each on the compressors and two of 150 h. p. each on the 20 inch crushers. All the rest of the motors are slip ring and all were furnished by the Allis-Chalmers Manufacturing Company except G. E. motors on the air compressors, the Mundy hoists, and the motors on the water pumps which latter are Lincoln. The electrical equipment in general is partly Allis-Chalmers and partly General Electric.

The Traylor Engineering and Manufacturing Company furnished the Bull Dog jaw crusher and the revolving screens. These latter are motor driven and back-geared. The gyratory reduction crushers were supplied by the Allis-Chalmers Company and all are direct driven.

Conveyors are all of the three pulley roller bearing type and were supplied by the Robins Conveying Belt Company. The belts came from the U. S. Rubber Company. The conveyors are driven through DeLaval speed reducers direct connected to the head pulley shafts. The 800 and 530 foot belts, being on considerable grades, have regenerative motors and their tail pulleys are equipped with solenoid brakes. Vibrating screens and their accompanying motor-generator set are from the W. S. Tyler Company. The Pennsylvania Pump & Compressor Company furnished the compressor plant and the centrifugal pumps. The P. & H. cranes came from the Harneschfeger Sales Corporation.

The building housing the compressors and the blacksmith shop is 30x90 feet and is equally divided. In the compressor room are two, two stage, intercooled and aftercooled, 1,300 foot machines discharging into a 54 inch by 12 foot receiver. Each compressor is driven by a G. E. 225 h. p. synchronous motor. From the receiver a 3 inch trunk air line runs along the quarry face and a second line runs through the entire plant to the wharf. The blacksmith shop is equipped with an oil furnace and a Leyner sharpener from Ingersoll-Rand, power drill and power grinder. The tempering bath is a concrete tank of 2,000 gallons capacity. In the water is immersed a steel tank of oil for tempering shanks. Both the water and the oil baths are kept agitated by compressed air with the result that their temperature remains practically constant and the temper of bits and shanks is remarkably uniform.

The quarry was opened with air drills and at present there are in use three I-R X71 drills and one Denver rock drill number 17, besides a number of pack hammers of both makes. Toe and vertical holes are drilled to about 20 feet depth, sprung several times and fired with 60 per cent dynamite. From 4 to 6 cubic yards of rock are

brought down to the pound of powder and very little blocking is necessary. Two Marion electric shovels, type 37 with 1¾ yard dippers, load the rock into a fleet of six 7½ ton Mack trucks, fitted with side dump bodies, for transportation to the primary crusher. The trucks are housed in a standard Truscon steel garage building 24x96 feet.

Crushing building number 1, is equipped with a 20 ton P. & H. crane with 5 ton auxiliary. During erection this crane handled crusher parts weighing nearly thirty tons. The primary jaw crusher is a 48x60, the frame of which is held together by links of forged steel instead of the usual cast steel. It is belt driven by a 200 h. p. 600 r. p. m. 2,200 volt slip ring motor and is safeguarded against breakage by tramp iron. From the jaw crusher the stone is fed into two 20 inch A-C Superior gyratory crushers. These are driven by 150 h. p. 720 r. p. m., 2,200 volt motors, direct connected through magnetic clutches. The product of these crushers falls into a concrete box of 12 cubic yards capacity which feeds onto a 30 inch conveyor belt 185 foot center of pulleys, leading to building number 2. The feed boxes at this point and above the 20 inch machines are ample to prevent flooding of the conveyor.

Crushing building number 2 is equipped with a 5 ton, hand traveling, P. & H. crane. The discharge end of the belt conveyor coming from building number 1 has a magnetic pulley for the removal of any tramp iron small enough to pass the preceding crushers. This conveyor feeds two 60 inch revolving jacketed screens. Throughs from the jackets may be by-passed to a conveyor with the commercial stone or, if there is sufficient top soil from the quarry, they may be passed over a Hummer electric screen, type 39-4 foot one surface tandem with V-32 vibrator, the throughs of which go on a 20 inch conveyor to a bin outside the building. The rejects from the jackets and the throughs from the main screens go to the lower of two 30 inch level belt conveyors, upper 200 foot center, lower 220 foot center, leading to building number 3, and the rejects from the main screens go to two 10 inch Superior reduction crushers direct driven by 100 h. p. 1,200 r. p. m. 2,200 volt slip ring motors. The product from these crushers feeds directly upon the upper of the two conveyors to building number 3.

Crushing building number 3 is equipped with two 5 ton Yale & Townsend crawls. The lower belt from building number 2 carries stone 1½ inch and under and this chutes directly into the second bin beneath the superstructure. Stone from the upper belt feeds into two 60 inch revolving screens the throughs of which pass into the second bin and the rejects go to two 7 inch Newhouse reduction crushers whose product also goes into the second bin. These Newhouse crushers are high speed machines with motors built into their upper parts and they hang suspended on heavy cables. As this is the first installation of these machines on trap rock their performance is being watched with considerable interest. By changing the lower plates in the revolving screens in buildings number 2 and 3, 2½ inch stone may be made and this goes into the first of the two bins under building number 3. Each of these bins has a capacity of 500 cubic yards live storage, and they feed the 30 inch, 800 foot conveyor which starts in the reclaiming section of the tunnel, under the bins. The grades of this conveyor and the tunnel have previously been noted.

The drive of the 800 foot 30 inch conveyor from building number 3 to silo number 1 is at the discharge end of the conveyor, on top of silo number 1. The conveyors from silo to silo are each about 50 foot center of pulleys and on rising grades of 20 to 30 per cent. When the 800 foot conveyor brings 2½ inch stone it is deposited directly in silo number 1 which has a capacity of 1,600 cubic yards. The other six silos have each a capacity of 1,400 cubic yards live storage. When 1½ inch and under stone is brought it discharges onto a short 30 inch conveyor belt to silo number 2.

On silo number 2 are two 60 inch open and revolving screens which reject 1½ inch stone and this drops into the silo while the throughs go on a 30 inch belt to silo number 3. On silo number 3 are two 48 inch closed end revolving screens, the 1¼ inch rejects from which fall into the silo while the throughs go on a 30 inch belt to silo number 4. On silo number 4 is a Hummer electric, 39-8 foot single surface, tandem with V-32 vibrator. This screen rejects ¾ inch stone and the throughs pass on to silo number 5 on a 20 inch belt. On silo number 5 is a Hummer electric, 39-4 foot one surface tandem with V-32 vibrator. This screen rejects ⅝ inch stone and the throughs go to silo number 6 on a 20 inch belt. On silo number 6 is a screen the same as on number 5 but rejecting ⅜ inch stone. The final throughs of screenings and dust go to silo number 7 on a 20 inch belt.

In the roof of the reclaiming tunnel under these silos are chutes, three under each silo and one under each overflow storage section between silos, which feed a 30 inch belt conveyor of which 380 feet is on a 10 per cent down grade and the last 150 foot level, discharging over the washing plant at the inshore end of the wharf. The overflow storage is fed from openings near the tops of the silos and for the present, trucks will be served from the outside piles of stone by small portable loaders.

The washing plant is of an original and highly efficient type developed at Tomkins Cove by William Berry and is known as the Berry Washer. The stone drops down a flight of sloping screens and shelves, interspersed by movable baffles which retain enough stone during operation to take all the wear. When these baffles are lowered all the

stone goes to the bottom. As the stone descends it is played upon by water at high pressure from rows of small, closely spaced holes in horizontal pipes, which turns the stone over and over and cleanses it thoroughly. The washed stone is fed on to a 30 inch, 230 foot belt conveyor running level over the wharf to the loading boom.

At right angles to the wharf conveyor is a 30 inch, 25 foot belt conveyor, in a counterbalanced frame, discharging into a swivel headed chute which may be so swung as to cover the entire width of a barge. The counterbalanced frame is raised or lowered by motors to suit the stage of the tide. Barges are handled by two lines from a 20 h. p. Mundy electric hoist, the lines running through Freidliner swiveled sheaves. Light incoming boats are tied up along a rack upstream from the outboard end of the wharf and, after being loaded, are set directly across the basin against a second rack to await departure.

River water is pumped to the washer by a 6 inch Waterous rotary pump with a rated capacity of 1,000 g. p. m. at 50 pound pressure. The discharge of this pump however may be varied between 750 g. p. m. at 35 pounds and 1,250 g. p. m. at 75 pounds. The effluent from the washer is carried through a ten inch steel pipe line, 1,300 feet long, to a point where none of the solid materials can reach the river. Provision has been made to sluice through this line when desired, the screenings and dust from silo number 7. Because of salt in the river, water for cooling the air compressors, the crusher and the Newhouse crushers is supplied from the city water system by a 2½ inch, 4 stage centrifugal pump delivering 100 g. p. m. through a 3 inch pipe line 2,000 feet long against a 405 foot static head, to a 30,000 gallon concrete tank near the compressor house. From this source circulating systems are supplied by small centrifugal pumps, one of which is located at a 3,000 gallon concrete tank near building number 3.

Personnel

Preliminary surveys were begun in 1924 by Mr. C. T. Allison, County Engineer of Rockland County. Early in 1925 the writer was engaged as engineer for the company and a little later the services of Mr. L. M. Anderson, draughtsman for the Allis-Chalmer Manufacturing Company, were secured. Under the personal direction of Mr. Sterling Tomkins, president of the Tomkins Cove Stone Company, the plant was designed and general plans were drawn. Toward the end of September, 1925, The Burrell Engineering and Construction Company of Chicago, E. Lee Heidenrich, Jr., Ch. Eng., were awarded a contract for building the plant. Detailed drawings were furnished by the contractor, and construction was started early the following December, with Mr. O. W. Holmberg in charge as superintendent. The time for the final completion of the plant was about thirteen months.

Proper Maintenance of Chain

Except in a few industries, chain might rightfully be considered of minor importance. In spite of the fact that the proper operation of many types of conveying and hoisting machinery depends entirely upon chain, the cost and application of chain is small in comparison with other individual items of equipment. But however small the part, it should be remembered that in "little things" frequently lie great costs—that every item of minor equipment should be afforded a degree of attention and maintenance proportionate to that given the major pieces. To the end that chain may have long life and give satisfactory service, we give here a few simple rules governing its care and application.

1. Every chain should be tested and fully inspected before being placed into service;
2. Every chain has a rated load-capacity. Never impose a burden greater than the established "safeload."
3. Never apply loads suddenly, nor jerk a chain.
4. Do not twist a chain, nor bend the links around sharp corners or edges.
5. Chains that show excessive wear or which have been stretched by over-loading should never be used.
6. Never force a hook into place by hammering.
7. Be sure every leg of a sling carries an equal load.
8. Do not spread the legs of double-sling chains more than necessary.
9. Keep the chain clean and well-oiled.
10. Inspect hooks, rings and chains frequently—

France Stone Rushing New Plant

The France Stone Company are constructing a new stone crushing plant at Monroe, Michigan. Already the structural steel work has been installed and it is expected that the plant will be in operation by April, 1927. The plant will be modern in every respect. It will be equipped with the latest machinery and it is planned to produce crushed stone of a quality and grading to meet all demands.

The new plant is to be of reinforced concrete and structural steel with metal siding and roof. The crushers will consist of one number 21, one number 8 and one number 7½ Allis-Chalmers. In the quarry pit there will be one or two steam shovels and two or three steam locomotives.

The stone will be taken in dump cars from the pit up an incline to the number 21 crusher. From the crusher the crushed material will be carried by a conveyor to the screen house, where it will be separated in various sizes. Oversized material will be returned to the number 7½ and number 8 crushers and reduced. There will be 14 reinforced concrete bins, 8 for loading on railroad cars and 6 especially designed for loading trucks.

DEVELOPMENTS IN THE USE OF EXPLOSIVES

WHEN quarrying first started in the United States, probably for the manufacture of lime, the bore holes were put down with hand drills and fourteen pound sledge hammers and were loaded with gunpowder, the only explosive then known. Later came guhr dynamite. Pure nitroglycerin was used in some tunnel operations, and probably, experimentally, in some quarries, but it was much too dangerous to come into general use.

Hand drilling was so slow and costly that the invention of machine drills was imperative and side by side with the development of new types of drills came the development of better, cheaper, safer and more specialized kinds of dynamite. From the hand drill to the air and steam percussion drill, the jackhammer drill, the well drill, and the modern hammer drill of the turbro and X-70 type, the explosives too have developed so that at the present time there are a number of different types of explosives especially adapted for quarrying.

Not so many years ago all dynamites and gelatins, the principal use for which, to the extent of about 90 per cent, is for underground work, were balanced in composition to give a minimum of poisonous fumes, that is, the oxygen carrying ingredients and carbonaceous absorbents and wrapper were so proportioned that theoretically, on perfect detonations, the only fumes would be carbon dioxide, nitrogen and water vapor. This happy effect is almost never achieved in actual practice because of the difficulty of obtaining the complete chemical reaction.

Recently it has been discovered that combining the same percentage of nitroglycerin with a greater amount of carbonaceous absorbent than is necessary results in a stronger explosive but one giving a relatively large amount of carbon monoxide, a poisonous gas. Explosives made on such a formula would not be at all suitable for use underground or in other places where ventilation is inadequate but in a good deal of open work—quarrying, construction and submarine work—the matter of poisonous fumes is secondary to the strength of the explosive. There is no reason for sacrificing the strength of the explosive in order to get respirable fumes in quarry work. This discovery therefore led to the development of the quarry gelatin and the quarry straight dynamites, which are materially stronger and just as safe, as stable and as efficient in every way, except for the fumes, as were the balanced formula explosives from which they were developed.

With the introduction of a new detonating agent in the form of cordeau, which insures the practically instantaneous initiation of the detonation throughout the entire length of the explosive charge, came an easy method of loading broken charges. Where weak spots, such as mud seams or horizontal crevices intersect the bore hole, sand or other stemming material can be loaded instead of dynamite, continuing with the dynamite after the weak spot has been passed, and the detonation will be carried by the cordeau through the stemming break in the load to the explosive below. This procedure cuts down the hazard from the weak material flying too far and also saves the explosive energy that would be wasted out of the mud seams and slips.

A still more recent development is the practice of using two and sometimes three different types of explosives in the same bore hole. In a typical case, there may be a hard stratum of rock at the bottom of the bore hole or a large toe requiring the strongest possible explosives; twenty or thirty feet above that may be fairly hard rock, but not requiring as strong an explosive as the bottom; and still higher up and nearer the surface, may be much softer rock for which a still different type of explosive is needed in order to avoid undue shattering. Generally, however, two explosives are all that are necessary—a strong, dense explosive in the bottom, and an explosive of low density in the top. These low density explosives are the most recent development of the explosive manufacturers and have been extensively used in the largest and most economically run quarries in the United States as a top load. Whereas a 5⅝ inch diameter bore hole will hold nearly fifteen pounds of gelatin to the foot, these low density powders will run less than ten pounds to the foot, the advantage being that the force of the explosion is distributed over a greater area per pound of explosive, resulting in less waste from spalls in the top of the bore hole.

It is not to be understood that quarries where the stone is of uniform strength throughout the height of the face can adopt low density powders for a top load with any degree of economy. Probably they cannot, but a great many quarries having a stratification varying in resistance can frequently get very satisfactory results by the use of a quarry gelatin in the bottom and a low density explosive in the top.

History File Valuable

A history file should be maintained for every piece of equipment. Starting with a 5x7 card when the item is received and installed, every inspection and repair should be completely recorded on this card, thereby providing a valuable history of the service of such equipment. This data will prove of great assistance to the plant executive at a later date when replacement equipment is being considered, or when plant additions are being contemplated.

RECENT PROGRESS IN CEMENT TECHNOLOGY

By C. H. Sonntag

CEMENT manufacture has had for some years the appearance of a business that has become pretty thoroughly standardized. Still, standardization does not necessarily mean stagnation, and as new methods and new machines are developed they find places in the industry if they are found to be of value, whether by increasing output, lessening labor, lowering fuel consumption, or in any other way increasing the over-all efficiency of the process. That is to say, the new idea must bring about a lowering of the ultimate cost of manufacture or give a new product so much better than the old that it can be sold even at an advance in price.

Cement makers usually consider the process as divided up into a number of consecutive steps, and in taking up recent advances in the art it will be well to bear this idea in mind more or less, as the various stages of manufacture will serve as subjects on which to base a statement of progress.

Raw Materials

The outstanding development under this heading is the construction of two mills to use blast furnace slag as one raw material. One of these is located in Buffalo and one in Cleveland, both in close proximity to an ample supply of slag. For a long time the use of slag in making cement has been confined to the mills of the Universal Portland Cement Company, and the new plant in Cleveland is under their control. There is no limestone near either of these new plants, and it will be brought to them by Lake steamers. The transport of crushed limestone on the Lakes has become quite a specialized business, with vessels fitted with unloading conveyors and elevators driven by the ship's own power, so that cargo can be discharged on any dock regardless of whether it has material handling machinery.

The use of marine shells as the calcareous ingredient of cement has proven entirely successful, and expansion along this line will depend on locating a suitable deposit within reach of a dependable market. Engineers are beginning to realize that other materials than those whose use has been hallowed by time will make cement. So long as the proper proportions of silica, alumina, iron oxide and lime can be finely ground and correctly blended before burning, their source is not of much importance except from the standpoint of cost.

Quarry Practice

This is characterized by improvements in technique with equipment now known rather than the discovery of any radically new method. The well drill is more popular than ever when the condition of the ground permits its use, and steam and gasoline engine driven rigs are being replaced by electric driven units supplied with power from the mill when not too far away. The distance that a drill is moved in a cement quarry is not great, but the ease of shifting a traction rig from hole to hole is so great that that type of machine is in much favor. A powerdriven sharpener for well-drill bits is on the market. It does as good a job in a minute or two as the old method, and saves both time and hard work, besides turning out a bit of standard shape.

Power shovels are coming more and more into use. Electric drive is always chosen when current, either from the mill or from a public service line, is available. The old railroad type shovel is giving way to the full circle swing machine mounted on caterpillar treads, and this can almost be called a universal quarry tool, as it can be moved anywhere under its own power, entirely independent of any track. If for any reason it is desired to retain the railroad type shovel it should be mounted on caterpillar treads instead of railway trucks. It then becomes independent of rails or track and the front caterpillars are set so far apart that no special jack arms are needed.

In applying electric drive to shovels the advantages of the direct-current motor are recognized, particularly its ability to exert a high torque at low speed. Hence direct-current motors are used, getting their current supply from a motor-generator set mounted on the shovel. Current is led to the machine by armored flexible cable, and is usually three phase 440 volts. On the smaller shovels the motor-generator set is a two-unit machine with induction motor, and the operating motors are manually controlled. On large machines the motor-generator set is driven by a synchronous motor and contains two or three generators, depending on the size of the machine, besides an exciter. Each of these generators furnishes current for one motion of the shovel, as digging, crowding and swinging. The torque of each motor is varied by adjusting the field excitation of its corresponding generator. In this way it is not necessary to make and break the heavy main operating current, and as the fields use only a few amperes the control switches are not hard to maintain. The switches are usually electrically operated from master controllers under the hands of the shovel runner. Upkeep of the large switches handling the heavy operating currents was one of the worst objections to the earlier electric shovels. The digging motor is of course the largest and most powerful, and some machines have two motors geared together for this motion, as two small motors can be accelerated and stopped

more quickly than one large one. This is in line with the builders' constant effort to shorten the time of a complete cycle.

The urgent pressure for production under which these machines work has caused a marked improvement in construction details. Machinery bases and frames once made of cast iron are now of cast steel. Gears that were once of cast iron with cast teeth are now made of cast steel and are machine cut.

For digging clay, especially from pits that are likely to be flooded, and where it is advisable to keep the machine on top of the bank, the drag bucket operated from a locomotive crane is best, and in this way will probably increase.

Crushing

As previously stated, some modern plants have their stone shipped in from a distance, and so have no quarrying or coarse crushing problem. Cheap transportation, usually by water, makes this possible, and the plant operators then have only the actual cement making machinery to care for, leaving the quarrying and crushing to experts in that field.

Most plants are not so fortunately situated, but it is realized that crushing for cement making is a different thing from commercial crushing. Since all stone must be brought to at least ball mill size, there is no object in screening out pieces of larger dimensions, and it is possible to carry out the whole process in two stages—first, a large gyratory or jaw crusher taking shovel-size rock; second, gyratory reduction crushers or swing-hammer mills for the final break-down. The elimination of screens greatly simplies the mechanical arrangement, and it is possible to break down 1500 tons or more of stone daily in a plant containing only one primary crusher, one secondary machine, and two elevators.

Some mills have a commercial market for crushed stone. In that case it is possible to set the secondary crusher for a product of the size desired and send the stream of rock through a separate screening plant from which the fines, which are seldom marketable, can be sent back to the mill. Sometimes a rather dirty stone can be made to give a clean coarse aggregate in this way.

Of course it goes without saying that all modern plants desire to receive rocks as large as the power shovel will handle, in order to cut labor and powder per ton to the minimum. An installation as simple as the one described above can be run by three men.

Material Storage

In order to secure continuity of operation there should be a storage of material ahead of the grinding machinery in each department. A number of modern mills have solved this problem by arranging things so that a single traveling crane can handle stone, clay, clinker, and gypsum, and one or two include coal also. In general this means a straight-line arrangement of machinery and kilns, with storage alongside the mill, but if the crane handles raw material only it can be at one end of the plant. In the first case the whole sequence of production depends on one crane, and when finances permit it an additional machine on the same runway will give a spare unit so that repairs will not mean a shut-down.

The question of clinker storage is in its nature somewhat different from that of other materials. A clinker pile is usually built up only once a year, when the stockhouse is dull and shipments are slow. It is cheaper to store clinker in the open during the winter, and grind it up in the spring and summer when demand is active rather than shut down in the winter or provide silo storage for winter grinding. The nature of the problem requires that the handling be done with a minimum of investment, and two machines stand out above others as especially fitted for this service. They are the locomotive crane with grab bucket, and the drag scraper. Storage served by the former can be indefinitely extended by lengthening the track, and locomotive cranes have been so used for a number of years. The drag scraper is not so well known, but its storage can be extended by lengthening the rope, thereby increasing the radius of the pile, by making a higher pile, or by using a larger part of the circle of which the pile is a segment. It is the general experience of mill men that, provided it does not get wet, clinker is easier to grind after having lain in storage than it is when fresh.

Raw Grinding

No radically new grinding machine has been produced lately, but improvements have been made on those in use. Simplicity and large units are the order of the day, and many designers of new mills seem to feel that these are best secured by using machines known variously as compeb, combination or compartment mills. Whatever the name, they consist of a short section constructed like the older ball mills, followed by a longer section of the same shell fitted like the old tube mill. There has been a constant increase in the size of these machines since their introduction and they are now offered forty feet long, which is probably not the limit.

Earlier compartment mills had simple screen partitions between the ball and tube mill sections. Operators soon found that the two parts do not always handle their proportionate share of the work of the whole mill. Some materials are easier to granulate than to pulverize, while with others the opposite may be the case. In fact the materials, especially clinker, may change in this respect from day to day. Builders now realize that the ball and tube mill sections should be kept as separate in function as possible, and so are providing that the product of the first section must be screened down

to a certain size before entering the tube mill, any oversize being returned to the ball mill for further reduction. This has been done while still retaining both sections in one shell, so that the simplicity of one unit operation is not sacrificed.

Wet and Dry Processes

Dust is not now considered a necessary concomitant of cement making, as it was not so very long ago. Especially for mills located in the vicinity of cities, careful control of dust is vital to operation, and this has probably been the deciding factor causing most of them to adopt the wet process. The compartment mill with slight modifications will grind either wet or dry. Engineers of other plants have advocated the wet process because of the very close chemical control of the raw mix that can be had, though with most materials the difference between the two processes is not as great as is frequently supposed. It is possible to design a dry plant so that practically as close control of the mix can be had as in a wet mill, but somehow it has only once or twice been done as elaborately as in wet mills, and the dry process really suffers in this respect through the neglect or indifference of its friends. It has the advantage of giving hot gas for waste heat boilers, but most new plants are able to buy their power at a price that eliminates the waste heat boiler and the power house. Many statements have been made pro and con as to coal consumption per barrel in kilns running on the two processes, but so far as known no kiln has been run both wet and dry in the same plant on the same raw materials under the same conditions, so that we have no absolutely comparative data.

Burning

The one noticeable trend in this department is that toward longer and ever longer kilns. It is reported that units 330 feet long are in use or building. Performance figures on such units are not available. Another development that will probably find a place in the art is that of welded kiln shells. One maker has already built one or two in this way, and reports that the welded shell may be thinner than the riveted one for equal strength, and can probably be furnished at a lower cost. The welded shells built were just as straight as riveted ones.

Gear trains and trunnions are being given more protection than was once common. It is likely that the next improvement will be the replacing of some of the open gears by an enclosed speed reducer directly connected to a motor. If properly carried out this will do away with the bevel gear, which gives more trouble than all the others. Several studies of kiln performance have been made, and among other things it has been found that 2 per cent oxygen in the stack gas gives better all-around efficiency than any other amount. This corresponds to about 11 per cent excess air.

Gas seals are much more commonly used at both upper and lower ends of kilns than formerly. They are almost a necessity at the upper end when waste heat boilers are used, to prevent dilution of the stack gas by cold air. At the lower end they are a part of the general idea of better construction of the fire hood, with a view to conserving as much of the heat in the discharge clinker as may be. The question of using rotary coolers in furtherance of this end and to make the clinker ready for immediate grinding appears not to be definitely decided.

The output of a kiln depends primarily on the draft, which is equivalent to saying that it is dependent on the rate at which the gaseous products of calcination and combustion are removed. There was not much chance for increasing production as long as natural draft was the only one in use, but the advent of waste heat boilers and induced draft fans has made it possible to increase the draft to a point previously unheard of. This course makes it possible to burn more fuel, and the result has been an increase in output of over 30 per cent in some cases.

Fuel Preparation

Present coal grinding machinery does not differ from that which has been in use for a number of years, but in building new coal grinding plants or re-designing old ones greater attention is paid to dust prevention and collection than heretofore. Some plants even wash the stack gas from their dryers.

Quite a number of years ago a socalled "unit pulverizer" was tried in a few cement mills, but was not retained. It ground the coal by a beater action and blew it into the kiln in one operation, and there was no storage of powdered coal. In the last three or four years improved forms of this machine have been finding places in power plants for firing boilers, and it is likely that they will be tried again in the kiln rooms of cement mills. The method of operation is attractive, as it does away with the separate coal house and powdered coal storage, with their attendant hazards. The advocates of these machines claim that coal carrying 8 to 10 per cent moisture can be used without drying, but there is some question as to the advisability of this practice. It seems safer to dry the coal before pulverizing.

It is advisable to always have a large supply of coal on hand. It must be handled mechanically, and there is one device for doing this that seems never to have received the consideration that it merits. This is the drag scraper bucket. It will stock out to any reasonable distance from a track hopper or from a pile built up by a short elevator, and will reclaim to the same or another hopper. It requires no track or overhead bridge-work. It is made in capacities far beyond the needs of any cement mill. It so thoroughly mixes and packs the

coarse and fine coal that access of air and the consequent tendency to spontaneous combustion are minimized. This device will find a place in the coal and clinker storage systems of cement plants when its advantages become better known.

Clinker Grinding

Nothing new has developed in clinker grinding practice except the lengthening of compeb mills as already noted. The use of wide, slow moving, long pitch drag chain to handle coarse clinker instead of the other forms of conveyor is increasing. Such a conveyor will run for long periods without attention. As in other parts of the mill, greater simplicity is the keynote.

Storage and Packing

Cement storage in silos is now so standardized that no other arrangement would be considered. Packing machinery is also standardized, and delivery of filled sacks on a belt conveyor to the car door is the rule. There is a very definite tendency away from the cloth bag in favor of paper, this being brought about by the introduction of the multiple wall paper bag. This package gives every reasonable protection and does away with the collection, counting and return of bags, including the freight charge, and eliminates sack cleaning and the endless disputes with customers over damaged and worthless bags. Its use will undoubtedly increase further.

Pumping Powdered Material

The Fuller Kinyon pump was originally developed to convey powdered coal, and there are many installations doing this work in varied industries today. Later it was found to work well on powdered raw material, though quite a bit of experimenting was required before just the right conditions were found. These served to make its application to cement pumping easier, and now the machine is used not only to convey coal from mills to kilns and dryers, but also to put raw material into and out of storage and into kiln feed bins, and it is also carrying cement from mills to silos and from silos to packers. Transport is through an ordinary iron pipe, usually four or five inches in diameter, which can be led in any direction by long radius bends, and may also be run to any reasonable height, so that the system both conveys and elevates.

Dust Collection

While no new principles have been discovered, systems already in use have received further application. Electric precipitation has not been taken up so extensively as cyclones and cloth filters, for its first cost is high and it is best adapted to very large quantities of gas, such as those from kiln stacks. Cloth filters are increasing in use around grinding, elevating and conveying machinery and packing machines. Cyclones will do rough cleaning only, but may be used ahead of either of the other two methods, or alone when complete purification is not necessary.

Power

A few years ago it seemed as if waste heat boilers would become an integral part of every dry process mill and some wet ones. So far as known, every modern waste heat boiler installation has been successful, but they have been put in by less than half of the mills of the country. The lines of public service companies are being rapidly extended, and those companies are finding that a cement mill is a very attractive load, particularly when the power factor is kept high by the use of large synchronous motors. Prices for central station power are being made that make waste heat boilers and an individual generating station undesirable from the financial standpoint, no matter how much one dislikes to see the heat in the stack gas wasted.

Research Work

Investigations pertaining to various phases of the industry are being carried out along three lines.

(1) A study of the individual steps in cement making. So far, work has been done with tube mills, with kilns as mentioned above, on the grindability of clinker, on the value of preheated air, as well as on other subjects.

(2) A study of the different applications of cement in the field, including its failures as well as its successes. This work ranges all the way from the strength of concrete structural members through the properties of concrete pavements to the behavior of cement tile in the soil, and covers all the possible applications of cement. One subject now under investigation is that of colors for cement mortar. This work is being done partly in the laboratory of the Portland Cement Association and partly in the field.

(3) A fundamental research into the constitution of Portland cement clinker and the phenomena of setting and hardening. A research fellowship has been established with the national Bureau of Standards, where every resource of science, including the new subjects of physical and colloid chemistry, will be brought to bear on the question. So far the existence of tricalcium silicate has been accepted, confirming the work of the Newberrys and later investigators. The existence of tricalcium aluminate is questioned, and that of the compound $8CaO.2SiO_2 2AL_2O_3$ has been disproven. Work such as this can not be done quickly, and requires knowledge and equipment of an exceptionally high order, but the results when obtained may be far-reaching in their effects on the industry.

Super-Cement

There has been a constant demand from consumers for a more quickly hardening cement than present market product. This has quite likely been the result of the publicity attending the advertising and selling of "ciment fondu." It has been found that the early strength of ordinary Portland cement can be markedly increased by careful control of the raw mix and by fine grinding, and some companies are now offering a "super-cement" whose short-time strength is superior to that of the standard product. This has brought about a certain amount of breaking-away from the standard specifications, and it appears as though the whole subject will be opened for another revision.

A review such as this must necessarily touch only the salient points in the development of an industry so vast as that of cement making, but it will at least serve to show the direction in which progress is being made, and the lines along which further changes may be expected.

Progress of Electric Shot Firing

A large percentage of the blasting in quarries, shafts and tunnels, and from 15 to 25 per cent of the blasts in mining operations, are set off electrically, according to data collected by the Bureau of Mines, Department of Commerce. Electric shot firing is only one method of igniting explosives, but it is rapidly spreading, and because of certain inherent safety features, should be encouraged, the Bureau points out.

Explosives have been fired electrically for several decades. Mountains have been tunneled, deep shafts sunk, extensive coal and metal mine workings excavated and, in times of war, railroads, buildings, bridges, and fortifications have been destroyed by means of electrically-fired explosives. Modern engineering depends so much on explosives that their safe and efficient handling and especially their detonation are of prime importance to all those connected with the use of explosive agents. The Bureau of Mines is interested in electrical shot-firing because of its use in mining, and especially because electric methods, when properly applied, are undoubtedly safer than other methods commonly used.

Electrical problems of many kinds must be solved in dealing with the various phases of electric shot-firing. Success in using an electric detonator is closely linked with the resistance of its bridge, the resistance of its leg wires, and the insulation of its current-carrying parts. The proper layout of a circuit where a number of shots are to be fired simultaneously depends not only on the types of detonators that are used and their arrangement and interconnections, but also on the source of power itself. Various types of electric shot-firing machines have been developed, and these offer still another field for study.

In investigations of electric detonators and electric blasting equipment, the oscillograph is valuable because it can record electrical activity over very short intervals of time. By its use more complete information about electrical performance can be obtained than by any other means.

The Bureau of Mines advocates electric shot-firing because, when properly used, it is the safest and most efficient practice. Electric firing permits absolute control of the time when any shot shall fire, and the order in which several shots shall fire.

Fire Equipment Needs Attention

Hand pump extinguishers, water barrels, pails, hose, and other fire fighting apparatus should have renewed attention now that freezing weather has come to stay. And in this connection it is well to remember that the addition of calcium chloride (commercial, 75 per cent) is perhaps the best means for making an anti-freeze solution for use in such equipment. The strength of the solution will of course depend upon the temperatures to which the apparatus is subjected, the following table, from the Bureau of Standards, being a proved guide in this respect.

The strength of a solution may be tested by the use of a hydometer which will indicate the specific gravity—a necessity where the solution has been standing for some time or where calcium chloride not freshly opened is being used. Because calcium chloride solutions weaken with time and exposure, all containers should be provided with close fitting covers. In addition they should be coated on the inside with asphaltum paint and have the addition of about a tablespoonful of lime to every three gallons to prevent acidity and subsequent corrosion.

Many plant superintendents use common salt to prevent freezing of fire fighting apparatus. This is satisfactory if the containers are wood and if the temperature never goes below zero. Salt solution will always rust metal, however, and not infrequently has a tendency to creep or crystallize on the container. Calcium chloride, it is felt, gives a much safer and more satisfactory solution.

The following table, calculated on the basis of 2½ gallons of solution follows:

Temperature at which solution will freeze	Water	Calcium Chloride	Specific Gravity
10°	2¼ gal.	5 lbs.	1.139
Zero	2¼ gal.	6¼ lbs.	1.175
10° below	2 gal.	7 lbs. 6 oz.	1.205
20° below	2 gal.	8 lbs. 6 oz.	1.228
30° below	2 gal.	9 lbs. 2 oz.	1.246

A. R. B. A. CONVENTION AND SHOW PLANS

THE American Road Builders' Association has now completed the plans for its Annual Convention and Road Show which will be held in Chicago, January 10 to 14, 1927, during Good Roads Week. The convention will be attended by highway representatives from every state in the Union and from foreign countries. Mr. H. K. Bishop of the Bureau of Public Roads is general chairman of the Program Committee and he has been assisted by Mr. Paul Tebbs, construction engineer of the Pennsylvania State Highway Commission, as chairman of the engineering section, and Mr. Sam Williams, vice-president of the Autocar Company, as chairman of the Constructors section.

Topics have been selected that are of special interest and importance to the highway industry. The men appearing on the program have also been selected because of the attention they have attracted in the activities of their state and foreign country.

"Governors' day" is the name given to the first day of the convention and invitations have been sent to governors of all the states and to a few former governors who are active or interested in a highway program. Sufficient acceptances of these invitations have been secured to assure a successful opening day.

During the afternoon of this day there will be a special trip arranged for the Governors to attend the Road Show in a body. Upon returning to headquarters the Governors will be the guests of President Shirley and the directors of the association at the Governors' day banquet. Mr. Fred Reimer is chairman of Governors' Day and will have charge of all activities.

Wednesday, January 12, will be known at "Pan American Day" and one half of the day will be devoted to papers presented by engineers from countries of the Western Hemisphere, outside the United States. Colonel R. Keith Compton is chairman, and the program will be jointly presided over by him and Mr. Francisco Diaz Leal, member of the Federal Highway Commission of Mexico. Provision will be made for the delegates of foreign countries to visit the Road Show and it is possible that a trip will be arranged after the Road Builders' banquet. President Shirley and the directors will entertain the delegates of the foreign countries at the Road Builders' Banquet, which will be held at 7 p. m. in the Grand Ball Room of the Palmer House. Mr. Paul Griffiths of the American Tar Products Company is chairman of the banquet committee. It is expected that 2,000 people will attend the banquet. Arrangements with a speaker of national reputation to be present are now being made.

"States Day" has been designed for Thursday, January 13, and this day is set aside especially for state engineers and officials to visit the show and also inspect the several state exhibits. Among the states that have already planned to send exhibits are Florida, Missouri, Nevada, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Virginia and others who expect to be present. Exhibits from Alaska, Canada, Mexico, Argentina, Cuba, Chile, Peru and from the Associations Bureau of Public Roads will also be there. Dr. F. A. Hathaway, chairman of the Florida Highway Commission is chairman of States Day. Special trains will be run from several states and a large attendance is expected on this day.

Reduced rates have been granted on all railroads, therefore, when a ticket is bought to Chicago the certificate should be secured from the ticket agent. This will be validated at the Coliseum and enable the return to be made at one-half price. The Coliseum Committee will be in charge of Mr. John E. Tate of the Portland Cement Association, who will have charge of placing the exhibits. Already over 300 car loads of machinery and materials have been arranged for display. Recently, the Wilson Building, which is adjacent to the Coliseum was secured to provide additional space as it is expected that this show will be the largest ever held.

William Ogden of the Lakewood Engineering Company will be in charge of the Registration Committee. The duty of this commitee is the registration of all those who attend the Road Show and distributing the registration lists.

The United States Bureau of Public Roads will have an interesting exhibit at the Coliseum. This will depict all conditions in the road field and finish with the exhibit of the highway commission of Utopia. Hotel accommodation is better than it was a year ago but owing to the increased attendance it will be wise to make reservation early. Use the Association Hotel Booklet and either write direct to Hotel or to Mr. William J. Hennessy, 10 South La Salle street, Chicago, who is in charge of the hotel committee. The headquarters of the association will be at the New Palmer House and the office will be opened after December 5, 1926.

The second annual College Essay Contest, conducted by the association, will close during Good Road Week and the prize winners will be selected by a committee and announced at the Road Builders' banquet. The announcement of the prize winners and also the speech of the principal speaker will be broadcast by radio.

MORE ENGINEER CRUSHED STONE EXECUTIVES NEEDED FOR 1927

By R. N. Van Winkle

PRESENT day conditions in the quarrying industry are imposing duties and difficulties upon the quarry executives which require solution, and it would seem appropriate, therefore, to outline in an article such as this the duties and difficulties that are confronting the responsible managing officer, so as to show, if possible, the extent to which they have been solved or unsolved, and, moreover, to show, if possible, what part the engineer has played in so doing. As a usual thing the engineer has to do with new construction and the revision of the old, but today engineers are stepping out of strictly engineering lines into industries, and are making good as executives.

The first and most important duty of an executive is to attain, as soon as possible, the maximum success in creating a sufficient margin between the cost and sales price of output. The necessary executive and administrative work to accomplish this one thing is quite often best done by engineers trained in this branch of knowledge, and while it is true the engineer usually has to do with new construction and the revision of old, this, of necessity gives him the chance and opportunity to get in on the ground floor, we might term it, and be familiar with all plant design and construction details which are unquestionably advantageous to him as an executive.

Another important duty of a chief executive is to select his staff or subordinates so as to attain the best results. To be able to have a fair knowledge of the industry as a whole and an intimate knowledge of the machinery and functions of each department so that he can intelligently approve or disapprove of whatever is laid before him by the members of his staff or subordinates and not be just a figurehead.

Quarries and crushing plants are opened up and designed for the sole purpose of creating the maximum output with the minimum unit cost, and the greatest efficiency will be attained by the quarrying executive who co-ordinates best all departments from stripping to sales and concentrates his activities on increasing output or production, the sale of which is his sole means of revenue.

The wise executive will spare no time in establishing an accounting system to keep track of earnings and expenses; to record the history of the operation. This accounting system, when properly installed and functioning, will act as a general inspector over the entire operations and it will expose poor results and many times offer means of correction, from it can be promptly worked up cost data of every important item of operating expense which should be put into the hands of all concerned. Approximately 40 per cent of our industrial activities result in waste and we can only hope to become more saving in this respect through the leadership of trained minds which can prevent waste and standardize the process. The engineer is a leader and teacher and if of the right sort, grows with his profession and can help to stabilize and standardize.

"The location of a quarry and crushing plant is giving it its constitution." If it is improperly located as to rock deposit, stripping and marketing conditions, it may never develop, but the writer for one honestly believes that regardless of how sick, how mismanaged a quarrying operation may be, if it has a good constitution, and by this is meant a good stone deposit, a fair crushing plant, good machinery and ample market, it can recover with the proper executive at the head of it. This executive must be a man with trained experience, a disciplined mind enriched with imagination, acquired skill and a large view of the meaning of things which attributes will reflect, in conjunction with the human worth, favorable results on the accounting sheet. When it comes to giving a quarry a constitution, the technical advice and consultation of an engineer is of great value and a thing quite often overlooked or entirely forgotten.

An executive must determine the justifiable outlay or expenditure to reduce operating costs. He must be responsible for interest charges, maintenance and depreciation costs and capital expenditures against possible savings, and quite often be responsible for providing the necessary capital if the investment is justified. He is responsible for balancing the entire enterprise. Here again the engineer should function due to his training in various other undertakings and his qualifications for the handling and analyzing of figures.

According to the U. S. census of 1870 only 1.25 per cent of the persons engaged in gainful employment were executives who planned the activities and directed the energies of the whole working force; in 1890 this had increased to 1.74 per cent, in 1920 to 3.6 per cent and in 1924 to 4 per cent. What percentage of these were engineers it is impossible to say, but the railroads in the United States in 1922 had eleven chairmen out of thirty-two or 34 per cent, and thirty-three presidents out of one hundred seventy-one or 19 per cent, who had risen from the engineering ranks. Also according to the National Industrial Conference Board, there is an increasing demand generally for the services of trained men and engineers. Mr.

George S. Davidson, president of the Gulf Refining Company, has said of the engineers the following in a recent address:

"The civil engineer deals with quantity, time, cause and effect. His problems involve dimensions, form and motion. He creates today and destroys tomorrow, but out of the destruction new forms arise of improved design and greater utility. Experience may be a guide for his future policy, but he cannot rest on repetition of methods that may have brought him fame. He must be alert to the ever changing conditions about him, recognize the problems they create, and apply wisdom and ingenuity to their solution."

Although a good technical expert may not develop into a good executive, and quite often he does not, nevertheless a successful administrator or executive should have certain characteristics, such as: the ability to think logically and quantitatively; exactness of method and power of analysis; sound economic theories; an unlimited capacity to learn; pronounced firmness combined with high sense of fairness and charity needed to control men, and the most important characteristic, the writer feels, the ability and habit of looking forward. The above are characteristics of a good engineer and a man with these characteristics should unquestionably make a high class quarrying executive, provided he is grounded and experienced in the fundamentals of quarrying.

In using the expression "engineer," the writer does not mean necessarily a college engineer or a graduate engineer, but a man who has had the capacity for becoming an engineer and has taken the opportunity of this capacity. A man is far from being an engineer just because he has attained graduation from an engineering school as it takes years of development in the school of life even then to become a finished engineer. To be possibly still more explicit on this point, the writer does not believe or have the idea that educational institutions can teach men to become engineers, captains of industry or executives. About all they can do is give men a thorough grounding in the fundamentals of engineering. What really counts is knowing or learning the methods of combining fundamental sciences with the dollars and cents proposition, know English in a way to enable them to express clearly what they know; so that others may profit by it, because it does none of us very much good to be ever so wise if we cannot express our ideas to others.

Whether you agree with it or not, quarrying, that is modern day quarrying, is quite a technical business and should be based on engineering principles and information. It is almost a profession and just because a man has been successful in other lines is no sign he will be successful as a quarryman. He can be if he is the proper sort of an executive and surrounds himself with the proper staff of subordinates, but it is too big a game to play alone. Just consider for a minute some of the subjects to be handled by the present day quarry executive:

Electricity with its kilowatts, volts and amperes.

Coal with its British thermal units (B. T. U.).

Lubrication with its many phases.

Dynamite with its many formulas, velocities, etc.

Drilling with its mass of details and large holes versus small holes.

Stripping with its various methods, hydraulic, steam shovel, drag line.

Locomotives, steam, gas or electric and the maintenance of same.

Cars—type, square box, rocker or special and maintenance or repair.

Track layouts, with grades, curves, weight, rails, etc.

Crushers, with regard to size, efficiency, openings, primary and secondary.

Screens, rotary, shaker or disc and the problems of proper sizing.

Accounting, with its cost systems, collections and banking.

Traffic, with its rates, car supply and contact with railroads.

Safety, with its liability and boiler insurance and safety first.

And many other subjects which do not come to the writer's mind at this time. The question is, can these subjects be handled by the "Rule of Thumb" or has the engineer helped and can he help further in the solution of these many and complicated subjects and problems?

Aside from the subjects covered above there is the question of sales. The direct sales or the supervision of sales of crushed stone can be handled in a great many cases most satisfactorily by the engineer, due to his experience with construction work in general. From his experience in different classes and types of construction he is more or less familiar with the sizes and grades of stone required for various undertakings and can not assist only the consumer in the buying of the proper size and grade, but is also a great help to the producing end in manufacturing and shipping products which if not up to standard will be refused at destination which causes no end of grief and loss of revenue.

A quarry that is "sick," as the writer calls it, does not necessarily need additional capital as is quite often thought, but more often a good dose of modern management administered by a high class executive will pilot the undertaking along the narrow pathway of success. When one visits a prosperous or well managed quarry, sees the mechanical devices installed, watches the output leave the plant in cars and train loads and by fleets of modern trucks, they cannot but realize that at some future time this great creation, we'll call it that for the lack of a better name, was born in some man's

brain and developed through competent engineering. Some people will doubtless disagree with that statement and say that quarrying plants and operation quite often have just happened, grown from a small local operation into a big industry by adding on and to the original installation by reason of necessity, rather than by any definitely planned system or ideas born in some man's brain. They might be right but an operation that just happens without being given serious thought and developed through competent engineering is very seldom successful or prosperous.

The close inspection of most any successful quarrying proposition will also show that all of them at some time or another have had difficult engineering problems, which have been solved by engineers of ability and experience. Although the work incidental to the actual operation of quarrying is more or less of a routine nature after once properly organized, engineering principles and skill are an essential throughout a successful operating career, for changes, additions and betterments are continually taking place, new machinery, new markets, competition and new problems of various natures are arising.

Tradition, or doing things as they have always been done before, seemingly is a weakness of quarry operators and executives. The methods employed by our neighbors quite often have too great an influence on the handling of the particular operation, when in fact engineering principles applied by a broadly trained and widely experienced engineer will serve the best needs. An engineer is not always necessary as there are many instances and many problems which the operator or executive can solve if he will but weigh and look on both sides of the question impartially, also make his conclusion on a sound basis of facts, eliminating tradition or outside influences, as these are basic engineering principles. Properly collected and positive data pertaining to any operation are an absolute necessity, as few, if any, economic problems can even be approached, let alone solved without using figures. This collecting and tabulating for ready reference, tonnage, cost figures, blasting data, drilling, records, etc., is, the writer has chosen to call it, the history of an operation and it is a physical, mental and moral impossibility to attempt to solve one's problems without the aid of systematic figures, records or history. Engineers, due to training, are quite often ably qualified for investigation, the collection, also, tabulation of data, for as a rule they take nothing for granted, are deliberate and painstaking in getting things up in proper form for quick analysis and ready reference, as it avails no one anything to have a mass of data and figures collected haphazardously and recorded or filed in the same way.

The writer wishes there was available the information or figures showing just how many quarry executives are engineers, but this information is not available as far as he knows. Engineers are, as a rule, poor salesmen of their own wares, poor advertisers of themselves, and too modest and quite often retiring. Even with these qualifications, we do not hesitate to search them out and use them when we have mechanical or electrical troubles, so why should we not try them as executives? Other industries are doing it successfully. There is no written treatise on the quarrying industry outside of the Pit and Quarry Handbook as far as the writer knows and he has been asked numerous times by young men engaged in the industry for books pertaining to quarry operation. There is no history of the industry. History is unquestionably being made, no one can dispute this if he has been familiar with the industry and noted the changes in the last ten years, but there is no one writing or recording this history in a logical way other than our trade papers. Engineers are trained observers and one of the qualifications of an engineer as set out in the forepart of this article was to be able to write, to know English in a way to enable them to express clearly what they know and engineers, as a class, are fast learning to reduce their observations to writing so that others may compile the results with the work of their fellows.

There appears to be a prejudice against the use and employment of engineers by a great many executives and owners in the quarry and open-pit mining industry. Maybe this prejudice is well founded owing to the fact that the term "engineer" has been greatly abused and overdone, and that they have been sickened by the term which means to them a college graduate with no practical experience as a salesman posing as a sales engineer. The engineer is in no different position than any man in any other walk of life; there are good and bad, but the engineer with the qualifications as set out in this article are the engineers that can help the individual and the industry and if there is a prejudice against him, it is unfounded and is a mistaken idea, as technical information, technical training and technical experience is an asset to any man.

The honest engineer should have but one attitude towards the industry in which he is engaged and that is to increase his knowledge of the basic principles of that industry and record every advance in the practices of that industry, to experiment and investigate using sure and sound principles and pass these on in so far as is practical by the use of writing on the subject to others interested in the same industry, so that we will not operate in isolation as we quite often do.

While competition is unquestionably the life of business, sales competition in the quarrying industry, especially in some districts, seems to be getting to the point where it is going to be the ruin of the industry in those districts. Executives

do not appear to be able successfully to cooperate with each other to stabilize the selling price of stone commensurative with production costs and investment. From what experience the writer has had in various localities and districts he is of the opinion that not a pound of stone should be sold at a cent less than $1.00 per net ton, if not more. In most instances this would give a proper spread between production costs and sales price. Personally he knows of stone being sold as cheap as 60 cents and another instance of where an executive with a moderate sized plant claims he is producing commercial sizes of stone for 30 cents a net ton. In both of these cases the executives in charge of these operations are mislead or are being misadvised as to their production costs as stone, that is to say commercial stone, cannot in this day and age be produced for 30 cents or marketed for 60 cents at any profit. Executives alone are responsible for the low selling price existing in some territories. Maybe in their effort and rush to book tonnage to keep their plants running, they are not as good business men and executives as they should be, as it avails no one anything to wear out machinery and deplete stone deposits just for the satisfaction of keeping one's plant running and holding an organization. If we could have more deliberation and more cooperation among quarrying executives in marketing of products and more proper history of operating or production costs, great benefits would be derived by all interested. Look at the explosive manufacturers, cement manufacturers and the steel industry and the stability they maintain in selling price. If it can be accomplished by them, why not by us?

Prospects for New Quarries In North Carolina

Prospects of the development of stone quarries in Chatham County, North Carolina, yielding material suitable in quality for all kinds of crushed stone and general building purposes, appear favorable from a survey of territory along the Bonlee and Western railroad between Bennett and Bonlee by Dr. J. L. Stuckey, State Geologist. The examination was made with the view of determining the value and quantity of both stone and clay deposits.

However the report of the geologist reveals that no clay of promise was found.

Stone existing in the vicinity consists chiefly of volcanic fragmentals, and flows of rhyolite, a hard, tough rock entirely suitable for all kinds of building and crushed stone. Three deposits of rhyolite were found in the neighborhood of Bennett, convenient to the railroad. Another location is about 2,000 feet from the railroad, on the north side, near to Bennett.

The most promising deposit of stone was found on the Polly Beek Mountain, about 2,500 feet south of the railroad and about two miles from Bennett. This hill is a ridge like formation several hundred yards long and several hundred feet high. Here it will be easy to develop a quarry face 30 to 40 feet high at a point sufficiently elevated above the valley for the quarry to be self drained. The stone exposed on this hill is a hard, tough rhyolite that will doubtless prove valuable for crushed stone and also for foundations, columns and similar work.

New Mexico Site Designated For Potash Exploration

Announcement was made recently by the Bureau of Mines of a drilling site in southeastern New Mexico, which has been designated as fifth in order of availability for potash exploration, in the joint investigation being conducted by the Departments of the Interior and Commerce to determine the location and extent of potash deposits in the United States, with a view to the development of a domestic supply sufficient to safeguard the interests of this country. This site is in the NW ¼ of Section 13, Township, 17S, Range 31E., Eddy County, New Mexico, approximately 35 miles east of Artesia. The exact site of the test may be within the quarter section specified. The site selected is on Government land, is at least a mile from any State or privately-owned lands, and is thus not affected by the clause of the enabling act which requires that leases must be negotiated by the Bureau of Mines with all owners of land or mineral rights within a radius of one mile of any proposed bore-hole before drilling operations can be commenced.

It is recommended by the Geological Survey that for this test a complete core be taken from top to bottom. This will give valuable information affecting the selection of other possible sites in this region and also bearing on the possible subsequent sinking of a shaft. The top of the potash-bearing salts should be reached at about 850 feet; the total depth recommended for drilling is 2,000 feet, which may possibly be shortened to 1,850 feet or extended to 2,300 feet, depending upon the showings of the core at the time of drilling.

In the selection of this site, the following factors have been considered: Proximity to an area of favorable showings; potential value of site for future mining; favorable conditions for drilling; accessibility; fuel and water supplies; and possible further investigation of an extended area.

Announcement has previously been made of the designation of four alternative sites in central western Texas, two in Upton County and one each in Crockett and Ector Counties. These four alternative sites, being located on privately-owned lands, are affected by the terms of the enabling act requiring the negotiation of leases with all land owners and holders of mineral rights within a one-mile radius.

MOORES LIME COMPANY IMPROVES PLANT

By E. D. Roberts

TAKING over the lime business built up by their father, at Springfield, Ohio, the two Moores Brothers, John and William H., have been able to keep the plants producing satisfactorily and also have maintained the excellent relations with the retail trade brought about by years of effort on the part of their father. At the same time they have brought about greater plant efficiency through changes and additions made to the plant and its machinery. Part of this success is no doubt due to the reliable character of the trade developed by their father but its continuance is due to the high standard maintained by the two sons for the two products: lump lime and hydrated lime. This has been accomplished in spite of a disastrous fire that recently completely destroyed the hydrating plant building with all the machinery used in that department, necessitating a reconstruction of the entire hydrating plant.

Two adjacent quarries are operated by the Moores Lime Company, each serving a battery of four upright steel kilns near the tracks of the Big Four and Erie railroads. The two parallel activities in the production of lime, located about 800 feet apart, were originally operated by different branches of the Moores family but competition, markets, and the lack of efficiency in the operation of this isolated small lime producing unit, caused the owners of the weaker company to sell out to the Moores Lime Company.

In the past there was a great demand for road stone which was served by a crushing plant installed by the Moores Lime Company near the kilns. This plant manufactured the crushed stone from the fines produced in getting out the lime rock for burning. However, there is little activity in this part of the company's operations at present and it is merely mentioned to account for the plant numbers and to show that the owners have looked into this phase of the economy of production, the utilization of by-products from the lime quarry. The rock crushing unit is designated as Plant number 1, the acquired quarry and kilns are listed as Plant number 2, while the Moores Lime Company's original quarry and kilns together with the hydrating plant is numbered Plant number 3. After the acquisition of the second lime producing plant by the Moores Lime Company, connecting tracks were constructed between the two quarries so that interchange of lime rock could be made, thereby making it possible to operate either or both batteries of kilns from either or both quarries as desired. This arrangement was especially valuable to ensure a continuous operation of the kilns in case of any quarry trouble which would shut off the supply from one of the quarries. Also by having two batteries of kilns the company is better able to meet peak demands for lime as it is imperative that orders from regular customers be filled promptly at all times if this patronage is to be maintained. The addition of a hydrating unit at the number 3 plant enables a more even operation of the quarries and kilns to be made.

As is well known to lime operators, lump lime should be shipped as soon as it is drawn from the kilns, but hydrated lime may be stored for some time when packed in air tight paper bags. Therefore, by hydrating the lime produced at plant number 3 and shipping the lime obtained at number 2 plant, both plants may be kept in operation which

Hydrating and Lime Plant

Loading Rock In Quarry

would not be possible if both plants had to depend upon the sale of lump lime.

Both quarries operated by the Moores Lime Company produce a high grade dolomite lime rock. No grit or other deleterious material is found in the rock after the removal of the overburden and there is very little waste after quarrying the rock, only the fines are wasted. This company intends to consolidate the two quarries in the near future and this has been made possible by the recent purchase of 15 acres of land which forms a wedge between the two quarries.

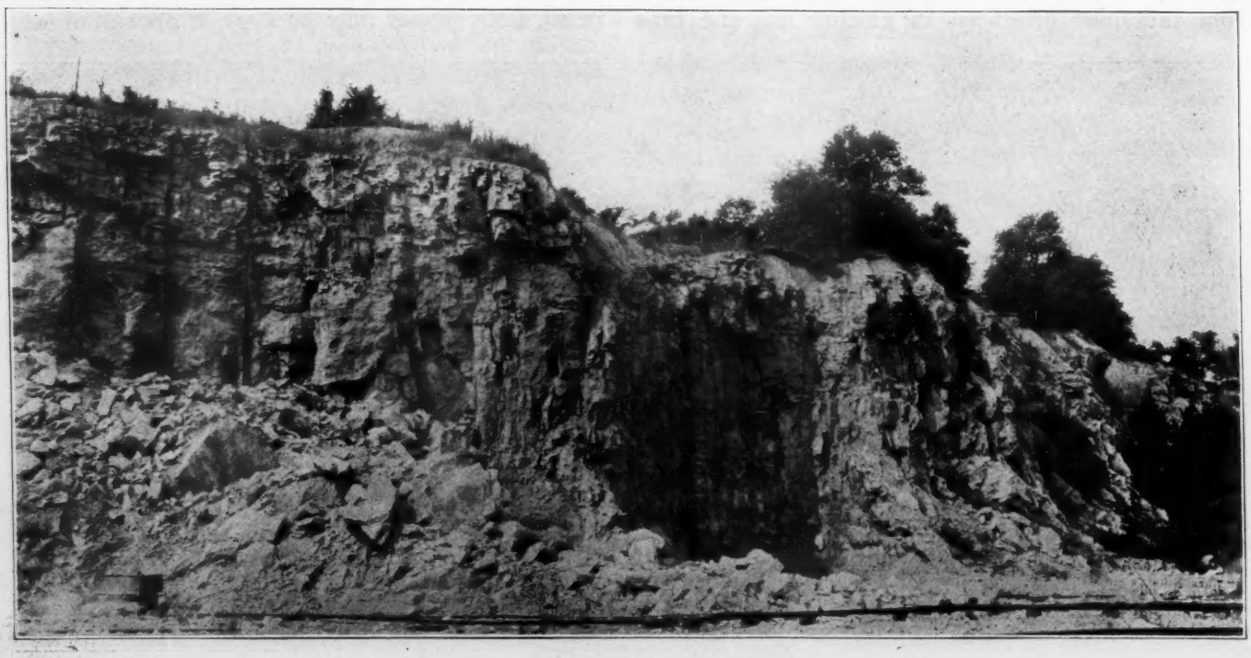
An average of ten feet of soil is removed in order to reach the lime rock, and this stripping is done by contractors during favorable seasons of the year. The working face, thus produced, runs 40 feet high for about 1,200 feet and 75 feet high for another 1,200 feet. The floor of the quarry is well above the high water level of the river drainage, so that water trouble is not experienced.

After the overburden has been removed the exposed rock surface is thoroughly cleaned before the well drills holes are put down for the placement of Du Pont dynamite. These holes are put down at intervals of 15 feet on centers and on a line 20 feet back from the face. A Loomis well drill, converted to electrical operation by the addition of a Robins and Myers motor, is used to drill the blast holes.

Ingersoll-Rand jackhammer drills are used to place block holes in the large boulders, resulting from the big shot, to reduce them to the proper size for handling. Two Easton quarry cars and some made by the company, are used to transport the rock from the quarry face to the kilns. All rock is hand loaded on a contract tonnage basis, the lumps being selected and loaded into cars after which the fines are loaded into other cars for wasting on the dump. Horses furnish the tractive power for the cars, delivering the loaded cars of lump lime on the scales at the lower end of inclines which lead to the kilns. After being weighed, the car is drawn up the incline by a home made hoist and the rock dumped into the kilns for burning.

In order to provide for the continuous operation of the quarries, in case the lime rock is being obtained faster than the kilns require and also to provide a surplus which may be drawn upon in case of quarry trouble, a switch track back has been constructed from the incline track to the kilns. This switch back is located far enough up the incline to allow the loaded car of lime rock to be run out on a trestle which is about ten feet from the ground. The surplus rock is then dumped from the trestle, forming a storage pile alongside the approach track below so that the rock may be reclaimed directly into cars ready to be hauled up the incline by the hoist and cable.

Each of the kilns is constructed of steel with an



Section of the Quarry

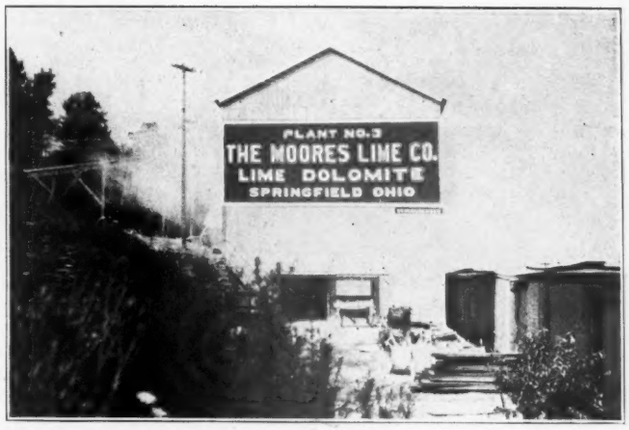
inner lining of fire resisting brick. The burning process used is continuous, the lime being dumped in at the top of the kiln and withdrawn from the bottom after it has passed down through the warming, burning and cooling zones. Natural gas is used for fuel with a reserve Wood gas producer for use in case the natural gas fails. One gas producer supplies both sets of kilns through a connecting pipe line.

With the length of cooling zone which is provided, sufficient cooling of the lime is made to enable the loading of lump lime directly from the kilns to the cars, and after the lime has been drawn from the kiln coolers into wheel barrows, it is wheeled into box cars for shipment.

Tracks have been provided from the drawing floor to the top of the kilns by two inclines and cars being loaded with the underburned lime transport it to the kilns for further burning. For this purpose a Sullivan turbine air hoist draws the cars up the incline from the burning floor to the second incline where the regular hoist takes up the load and hauls it to the top of the kilns.

In case the production of lump lime is ahead of the immediate shipping schedule, the excess lime is discharged from the barrows into a Sturtevant crusher, set in the floor close to the kiln discharge of the number 3 battery of kilns. This crusher discharges the pulverized lime into a Webster steel encased bucket elevator which carries it to the top of the building. From the elevator discharge, the lime then falls into a large steel tank which holds 130 tons. This steel storage tank is hoppered so that the material will flow by gravity to a common point where a feeder has been inserted in the tank bottom to control the flow of the lime from the storage tank into a hydrator located directly below.

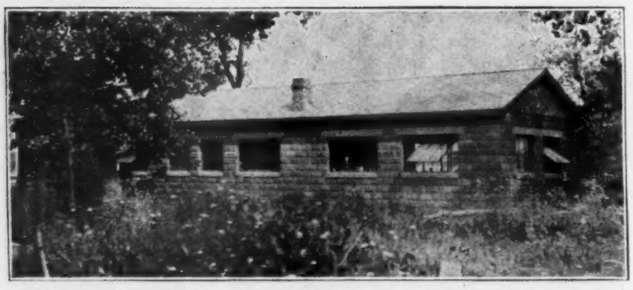
The hydrator, a Kritzer, consists of five steel cylinders, placed one over another, in which paddles revolve and force the lime through the cylinder to its far end where the lime falls through a connecting pipe into the cylinder below. This sequence of operations is repeated until the lime passes into the last cylinder. The proper amount of water is added to the lime as soon as it enters the hydrator and the continuous stirring soon produces a creamy paste which is very hot due to the heat generated by the slaking process. The lower runs of the hydrator serve as coolers to reduce the temperature and also dry the now thoroughly hydrated lime.



End View of Hydrating Plant

When the hydrated lime is discharged from the lower cylinder of the hydrator, it falls into another Webster bucket elevator that elevates the hydrate and discharges it into a screw conveyor. This conveyor also helps in cooling as well as transporting the hydrate to the pulverizer. The pulverizer, a Raymond, reduces the hydrate to a powder so fine that it is easily carried off by the air current which is furnished by a number 11 Raymond exhauster. The dust is then collected in a Raymond collector located over a 40 ton steel bin. This bin serves as a feed bin to a four valve Bates valve packer located directly below. The Bates packer then places the hydrate in 50 pound paper bags which are

View of Kilns at Plant Number Two



Office and Chemical Laboratory

marked with the Moores Lime Company's trade name of WHITEKOTE.

Three General Electric motors furnish power for operating the hydrating units: one motor, through a Palmer Bee speed reduced operates the hydrator, the bucket elevator that receives the hydrator discharge, and the 16 inch screw conveyor; another motor drives the Raymond pulverizer; while the third is directly connected to the fan of the exhauster. The new building which houses these hydrating units is constructed of structural steel and covered by corrugated iron, making a fireproof structure. The building is large enough to provide ample storage for the sacked hydrate without crowding the space allotted to the hydrating machinery.

At the west of the hydrating plant, is located a new one-story concrete block structure which serves a triple purpose. One end section provides a housing for the new Sullivan air compressor and motor; the center section is used for the company's office while the other end is used for a chemical laboratory where the chemist, Mr. H. P. Bailey, makes his analyses of the lime and hydrate produced by the Moores Lime Company. The success of this company is largely due to the careful supervision of their chemist, for in the manufacture of hydrated lime it is essential that the proper amount of water be added to thoroughly slake the lime without an excess of water which would produce a putty and consequently impair the value of the hydrate.

Alongside of this new building, a deep well has been sunk, reaching a water bearing strata 90 feet below the bed of the river. A Sullivan air lift pump raises the water to the surface and delivers it to the tanks which supply the hydrating machine. This is another new installation that has been made by this company to improve their product, because previously when river water was used for hydrating the lime, considerable discoloration of the hydrate was experienced during periods of high water with the river water carrying silt in suspension.

Thirteen houses, owned by the company, located across the railroad tracks from plant number 3, provide housing for the families of many of the workers employed in the quarries and plants. These houses have helped to maintain an even supply of labor for plant operation, offsetting somewhat the disadvantage of the plant being located at some distance from the city. The two Moores brothers attend to all the business of the company. John Moores is president and active manager of the plant operations, while his brother William H. Moores is secretary and treasurer and handles all sales. Their main office is located at the plant which is about four miles west of Springfield, Ohio.

American Lime and Stone Company Erects New Bunker

The American Lime and Stone Company has erected a new concrete pebble lime bunker at plant 19, Bellefont, Pennsylvania. This bunker has been erected just east of the number 4 bunker which was built last year and will have a conveyor to fill it, taking pebble lime across the top of number 4 bunker and another conveyor running through a tunnel beneath the tank to deliver lime back into the present elevator.

A new arrangement is being developed in connection with the pebble lime storage, whereby all pebble lime will be screened of one-quarter inch and finer material before being placed in storage and will again be screened before being loaded into cars. A steel tank of 115 tons capacity is to be placed alongside of number 4 bunker and a vibrating screen is to be inserted between the elevator and conveyor. This arrangement will improve the appearance of the pebble lime and at the same time will give a considerable tonnage of lime which now has to be produced by grinding in another part of the plant. Arrangements are being made for bulk, barrel or other methods of shipping.

Number 4 bunker is sixty-four feet above the ground, forty feet wide on the inside and holds 1700 tons of lime. The new bunker, known as number 5, is the same height as number 4 but is forty-eight feet six inches inside diameter and will hold approximately 2400 tons of pebble lime. Excavation work for foundations for the new bunker was started September 27, the work being done by the company's own forces. The contract for actual construction was awarded to the Spencer Construction Company who built number 4 bunker. The same method which was followed in building number 4 was again used for the new bunker, that is, sliding forms which were raised continuously as the work of pouring the concrete progressed. Pouring of the concrete started on Monday, October 25, and continued without interruption night and day until the side walls were finished on Monday, November 1, just eight days after starting. Hydrated lime was used in the concrete in both foundations and side walls and the result is that the bunker has a beautifully smooth, finished appearance.

HIGH TEMPERATURE ON HARDENED CEMENTS

By K. Endell*

EVER since Portland cement has been used for structures which are entirely or partially subjected to higher temperatures, such as factory chimneys, drying rooms, coke-quenching towers or coal and coal dust bunkers, the question of the action of high temperatures on concrete construction has been of great industrial importance. In the case of accidental and destructive fires, observations have been made as the occasion offered and have shown the definite serviceability of concrete structures. The low degree of penetration of fire damage has always been remarkable, as concrete is a relatively poor conductor of heat. It has seemed important to clarify these problems by laboratory tests, although it has been frequently determined experimentally that concrete or cement mixtures which have been completely unsatisfactory in small scale tests have proven completely satisfactory in the case of large structures in actual practice. The available literature contains so many contradictions that a determination of the mode of action of high temperatures on hardened cement aggregates and concrete seemed to be a fruitful field for research. Thanks to the assistance given to me by the Association of German Portland Cement Manufacturers, it was possible for me to investigate this field. From the present report which I am making on the current status of my work you will recognize that I apply scientific methods but pay little attention to theoretical considerations. The more I learn about technology and the interesting problems which it offers, so much the more important does it seem to me to serve it principally and not to permit the development of a scientific frame-work to become a purpose in itself.

Literature

A good review of previous work as well as of practical results is found in the work of A. Kleinlogel (Einüsse auf Beton, 2nd ed., 1925; section "Wärme," pages 374-395). Most of the articles considered the decrease in mechanical strength of mortar or cement mixtures after a shorter or longer heating at temperatures up to 1,000 degrees C. The extremely important question as to within what temperature ranges the "water" is driven off, strange to say, has received no attention. Serviceable measurements of heat expansion have hitherto been carried out only to 97 degrees C. The behavior of the aggregate has been observed, but confusion seems to prevail. However, the following conclusions may be drawn:

1. The strength of mortar or concrete mixtures under compression decreases with rising temperature.

2. Quartz or quartz containing aggregates are to be avoided where high temperatures are to be met. For these purposes basalt, limestone, blast furnace slag or burnt brick are more suitable.

3. Driving out of water from hardened cement requires time.

In my own researches I distinguished sharply between hardened cement, aggregates, and cement mixtures. In the case of hardened cements the union of the water and the loss of water with rising temperature was particularly carefully investigated. The coefficient of heat expansion was at the same time measured separately on various hardened Portland cements in aggregates and in cement mixtures up to 800 degrees C. From the results conclusions were drawn which are of service to scientific knowledge and give certain information for practical applications.

Loss of Water

As test materials I used cylinders and tubes 100 mm. on an edge of four different kinds of hardened pure Portland cement which were aged in air, under water, and by the combination method. The results of the standard testing of these four samples of Portland cement placed at my disposal by the co-operative laboratory are shown in Table 1. The hardened cement samples at the time of the tests were two to three months old.

(a) Dependence of Loss of Weight on Heating on the Temperature and Time

The nature of the loss of water in the case of hardened cement as a result of the action of heat and the decrease in mechanical strength resulting from it seem to me to be of great importance. It seems obvious to attempt to relate both properties. After preliminary samples had shown a very strong water binding action, samples of the four aged and hardened Portland cements—a total of twelve samples, consisting each of 0.5 grams of finely powdered material (residue on the 900 mesh screen* 0 per cent, on the 5,000 mesh screen 20 per cent)—were heated in the drying oven or electrical furnace with exact temperature control and temperature measurement, each for one hour at 100, 200, 300, 500, 700 and 1,000 degrees C., as well as five hours at 100 and 500 degrees C. Previously the total loss of heating on all the samples at intervals of a month was determined twice; the results are contained in Table 2.

*From Zement, November 11, 1926.

*In European practice a 900 mesh screen means 900 meshes per square centimeter or 30 per linear centimeter, which is about 75 per linear inch. 5000 mesh is about 175 per linear inch.

TABLE 1
Results of Standard Testing of Four Portland Cements

	Cement Sample No. 1	Cement Sample No. 2	Cement Sample No. 3	Cement Sample No. 4
Fineness				
900 mesh per cm^2	0,1 %	0,5 %	0,1 %	0,1 %
5,000 mesh per cm^2	5,5 %	18,8 %	8,2 %	7,3 %
Weight per liter				
Run in freely	1,122 kg	1,228 kg	1,135 kg	1,015 kg
Shaken down	1,842 kg	1,970 kg		1,658 kg
Specific Gravity				
Original	3,106	3,041	3,089	3,030
After heating	3,153	3,117	3,121	3,152
Setting Data				
Water added	26,5 %	23,5 %	27,5 %	26,5 %
Rise in temperature	2,1° C	1,8° C	1,6° C	2,2° C
Initial set	2 hr.50 M.	4 hr.20 M.	3 hr.55 M.	4 hr.45 M.
Final set	5 hr.50 M.	5 hr.35 M.	5 hr.55 M.	8 hr.15 M.
Constancy of Volume, Water Test and Air Test				
After 28 days	Satis-factory	Satis-factory	Satis-factory	Satis-factory
Boiling test	"	"	"	"
Compression and Tension Strengths 1:3 Standard Sand				
Water added	8 %	8,5 %	8,5 %	8,25 %
Strength in kg/cm² after	tens comp	tens comp	tens comp	tens comp
7 days water aging	30,9 398	23,3 232	26,9 286	22,1 236
28 days water aging	33,1 463	36,0 365	29,6 378	28,1 365
28 days comb. aging	49,1 578	43,4 427	39,8 402	38,3 429
Chemical Analysis				
Insoluble	0,10 %	0,26 %	0,30 %	1,15 %
SiO_2	20,76 %	21,84 %	21,14 %	22,59 %
Al_2O_3	6,24 %	7,24 %	6,81 %	5,37 %
Fe_2O_3	2,76 %	2,46 %	2,87 %	2,81 %
CaO	65,02 %	64,82 %	62,76 %	61,73 %
MgO	1,90 %	1,25 %	1,87 %	1,04 %
SO_3	2,20 %	1,08 %	1,72 %	1,61 %
S.-S.	0,03 %	0,01 %	0,02 %	0,00 %
Loss on Ignition	0,87 %	0,77 %	1,74 %	3,56 %
Difference	0,12 %	0,27 %	0,77 %	0,14 %
	100,00 %	100,00 %	100,00 %	100,00 %

TABLE 2
Loss on Ignition of Hardened Pulverized Cement in % After Heating to Various Temperatures

Water added to the moist samples.		20,0			20,05			19,0			19,0	
After ½ hr at 1000°												
July 1-3, 1926	18,6	22,0	21,0	19,0	23,0	18,5	18,0	22,0	20,0	17,0	23,0	19,0
After ½ hr. at 1000°												
Aug. 1-3, 1926	18,0	21,7	20,6	19,0	20,8	18,0	18,6	20,8	20,6	17,8	19,0	18,2
After 1 hour at												
100°C.	4,4	5,4	5,2	2,9	5,1	4,5	3,2	5,7	4,1	3,2	5,2	4,5
200°	6,6	6,7	7,5	4,3	8,1	8,3	4,3	8,7	5,9	4,9	8,8	8,0
300°	7,1	10,9	10,3	5,2	11,1	9,6	5,2	10,9	7,8	6,2	10,7	8,3
500°	10,0	12,3	12,2	8,0	12,0	10,3	7,7	12,0	10,5	8,3	12,6	11,6
700°	15,8	16,8	17,1	14,6	18,3	17,8	14,2	17,7	14,7	12,7	17,3	15,8
1000°	17,7	19,8	18,6	18,1	22,4	19,9	17,8	20,5	19,0	16,2	20,6	18,9
After 5 hours at												
100°	4,8	5,9	5,4	3,2	5,2	4,7	3,5	5,6	4,3	3,7	5,4	5,3
500°	10,0	11,6	11,6	7,2	12,0	9,7	8,4	12,6	12,0	8,2	12,8	11,4

TABLE 3
Linear Coefficients (% of Original Length) of Expansion of of 4 Cements

No. of cement sample		1			2			3			4	
Type of Aging	Air	Water	Comb.	Air	Water	Comb.	Air	Water	Comb.	Air	Water	Comb.
100°	0,02	0,01	0,05	0,01	0,0	0,08	00,1	0,04	0,06	0,01	0,06	0,06
200°	0,03	0,02	0,07	0,01	0,0	0,11	0,01	0,07	0,09	0,01	0,08	0,08
300°	0,03	0,0	0,0	—0,02	—0,03	0,06	—0,1	—0,01	0,06	—0,03	0,0	—0,02
400°	—0,17	0,0	—0,09	—0,11	—0,07	—0,03	—0,3	—0,08	0,06	—0,18	—0,2	—0,25
500°	—0,3	—0,01	—0,1	—0,26	—0,07	—0,23	—0,4	—0,11	0,05	—0,31	—0,41	—0,4
600°	—0,49	—0,01	—0,11	—0,53	—0,07	—0,49	—0,57	—0,16	—0,03	—0,51	—0,65	—0,65
700°	—0,56	—0,02	—0,12	—0,56	—0,07	—0,54	—0,58	—0,17	—0,04	—0,56	—0,72	—0,68
800°	—0,58	—0,03	—0,13	—0,55	—0,07	—0,52	—0,58	—0,17	—0,04	—0,58	—0,72	—0,68

The values of loss of water are represented graphically in Figure 1 for the four Portland cements, separately for air and water aging. From the table and the "loss of weight on heating" curves it appears that the loss of water proceeds very slowly. At 700 degrees the maximum loss on heating has been by no means attained. It is noteworthy that after heating for five hours to 100 or 500 degrees almost the same loss of weight was found within the limits of error as for heating for one hour only. From this it is to be concluded that at least for the temperature selected, a given temperature determines a given loss on heating. Such a type of loss of water on heating is, however, characteristic of the gels or the special silicates of the zeolite type. In view of the limited amount of observations, I do not desire to draw any further conclusions at the present time.

(b) Heating Curves

For the sake of completeness, heating curves were made of the cements which would serve to indicate the presence of any compounds and to show up the temperature ranges within which any sudden loss of water occurs which necessarily would be tied up with the production of a porous structure and loss in mechanical strength.

About 0.2 grams of finely pulverized hardened cement were heated in a suitable platinum furnace

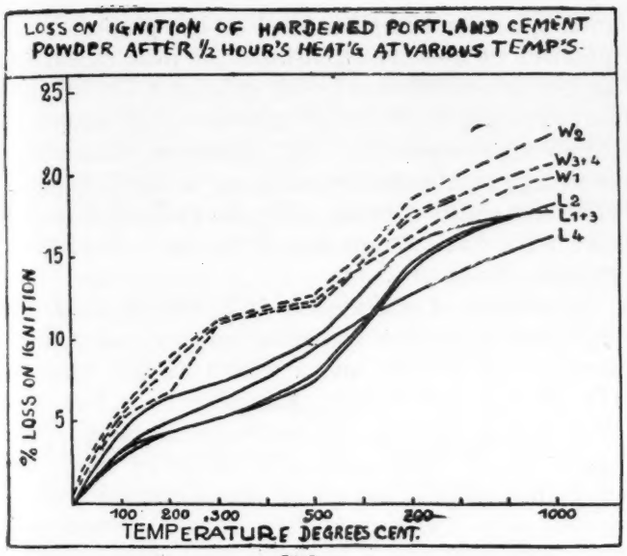


FIG. 1

and platinum crucible (the experimental procedure is described in the article of K. Endell, "The Thermal Phenomena on the Heating of Cement Flours," Zement, 1921, page 16). The rate of heating was about 20 degrees C. per minute. For these experiments the four samples of Portland cement aged under water, as well as cements No. 1 and No. 4

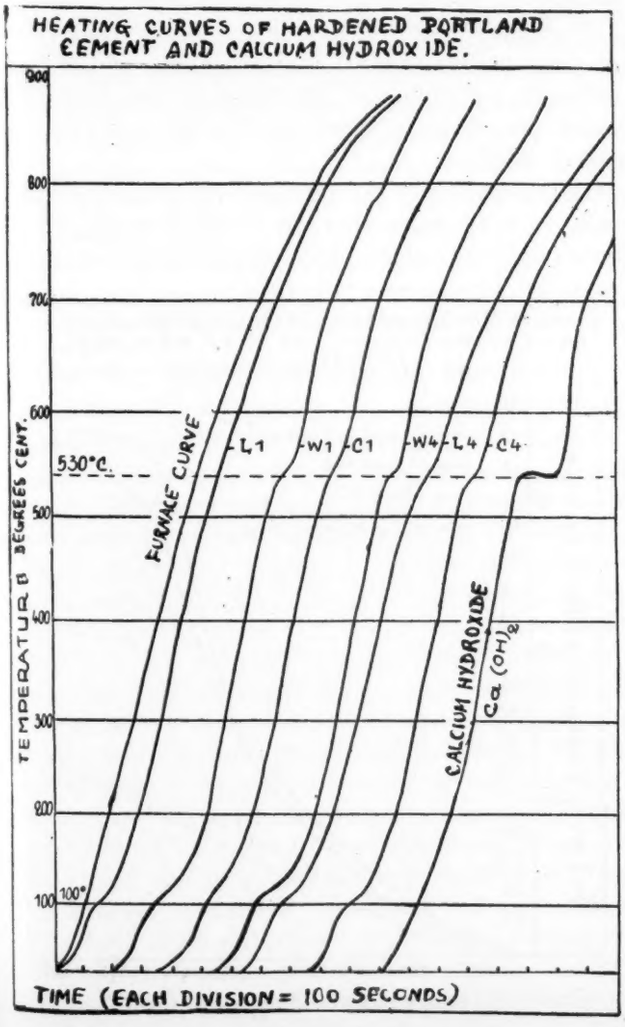


Fig. 2

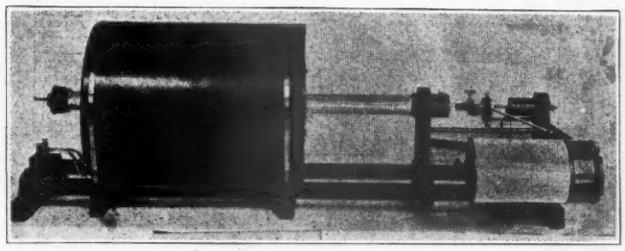


Fig. 3
Automatic Recording Coefficient of Expansion Apparatus

aged in air and by combination method, were used. The six heating curves of cements No. 1 and No. 4 are represented graphically in Figure 2.

Heating Curves of Hardened Portland Cement and of Calcium Hydroxide

All the curves show a strong absorption of heat at 100 degrees C. This consumption of heat is tied up with the loss of the loosely held water. Besides this, five of the curves, as well as the other two curves not shown here, show a distinct second break in the heating action at 530 degrees C. At this temperature there must occur the breaking up of a definite compound. Earlier experiments which I made with calcium hydroxide [$Ca(OH)_2$], containing 24.4 per cent H_2O and 75.6 per cent CaO, the heating curve of which is also given, showed that the phenomenon was due to the effect of the calcium hydroxide.

This result agrees with the observations of S.

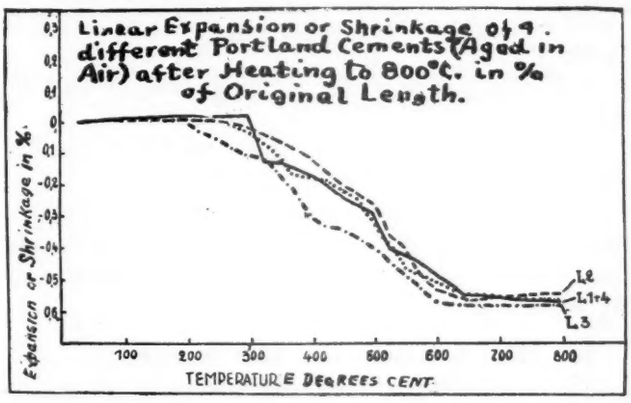


Fig. 4

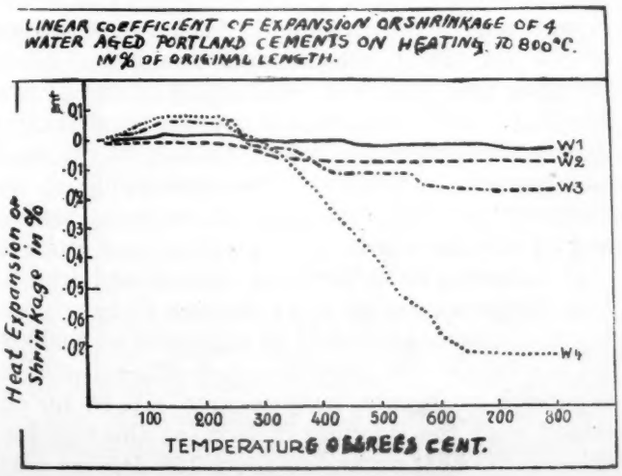


FIG. 5.

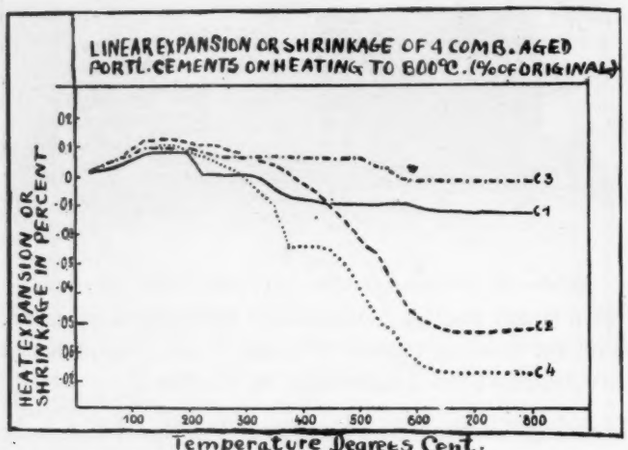


Fig. 6.

Kaisermann ("The Hydration and Constitution of Portland Cement," Kolloid Chem., Beihefte, vol. 1, 1910, pages 423-453) who had determined by crystallographic means the presence of calcium hydroxide in hardened cement; the results also agreed with the data of H. Passow, Jr. ("Method for the Determination of Free Lime in Set Portland Cement and Examples of Its Use," Zement, 1923, pages 87-89 and 96-97), who determined the separation of lime during the hardening of cement by means of its interaction with ammonium carbonate.

(c) Modes of Water Combination

The dehydration tests of hardened Portland cement thus show that we have three kinds of water held:

1. Loosely held water which is lost at 100 degrees C.
2. Combined water in the compound calcium hydroxide which is lost at 530 degrees C.
3. Water held absorptively or in zeolite fashion which is lost slowly and regularly with increasing temperature and whose last traces disappear only at 1,000 degrees C.

Heat Expansion to 800 Degrees C.

The coefficient of heat expansion is of importance in the resistance to fire of structures produced with the use of cement and aggregates. The actual value of the coefficient of thermal expansion is less important than the determination as to whether the expansion on heating changes continuously with temperature at all temperatures under consideration—that is to say, to at least 800 degrees C. Similarly, the relationship of the coefficient of heat expansion of hardened cement and of the aggregates to each other is of interest.

It is known that hardened cement and iron at least temperatures up to 97 degrees C. have practically the same coefficient of expansion of 0.00001. All the data in the literature on coefficient of heat expansion at higher temperatures are to be accepted with the greatest caution, as the relationships of the heat expansion above 100 degrees both for hardened cement and for the various aggregates are very complicated. For the proper determination of these relationships, the heat expansion apparatus constructed by my colleague, Dr. W. Steger, specially for keramic purposes, and shown in Figure 3, was used for heat expansion data on cement, aggregates and concrete up to 800 degrees C. (This apparatus is produced by Atom-Studiengesellschaft für Erze, Steine und Erden m. b. H., Berlin, Steglitz, Breitestr., 3.)

By means of a diamond drill, cylinders of the hardened cement or concrete were cut out with a diameter of 28 mm. and a length of 100 mm. At the Bureau for Testing Materials rods 100 mm. long were sawed from the various aggregates. They had a square cross section of 18 by 18 mm. The coefficient of heat expansion was automatically recorded on a registering cylinder and the temperature was measured at regular time intervals.

(a) Hardened Portland Cement

On account of the very firm union of the water in the cement, difficulties were to be expected in the determination of the coefficient of heat expansion. It was to be assumed in advance that as a result of the loss of water, shrinkage phenomena would appear which would compensate for the heat expansion, and might even exceed it in value.

The individual results for the linear coefficient of temperature expansion or shrinkage of the four different cements are tabulated in the following table, No. 3, in hundredths of a per cent of the initial length.

In Figures 4 to 6 the data are represented graphically. In all cases there is a small coefficient of heat expansion which proceeds generally only about

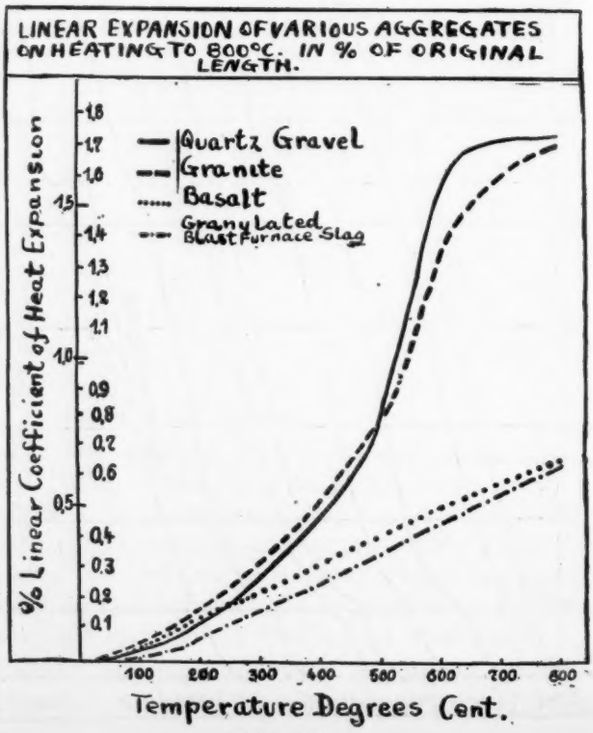


Fig. 7.

to 200 degrees and then a more or less markedly strong shrinkage occurs, which in individual cases amounts to 0.7 per cent at 800 degrees. The shrinkage proceeds smoothly and seems to correspond to the slow loss of water with increase of temperature.

According to the heat expansion experiments, all the cement samples seem to have a loss of weight on heating amounting to 6 to 8 per cent and apparently is so high because the cement samples in the closed system of quartz glass tubes were present in an atmosphere of saturated water vapor.

(b) Aggregates

The following aggregates were investigated:

1. Quartz gravel such as is obtained along the Rhine and is much used for concrete.

2. Lousitz granite containing microcline and biotite. The dried material has a comparative strength of 2,300 kilos per square cm.

3. Saxon columnar basalt with a compressive strength of 5,700 kilos per square cm.

4. Granulated blast furnace slag which under the microscope showed typical crystals of mellilith.

Figure 7 shows the course of these heat expansion curves and it is to be noted that after the experiments the quartz gravel sample and the granite sample had become quite weak, while basalt and blast furnace slag had hardly diminished in strength (Figure 7). The quartz gravel and the quartzitic granite had a high absolute coefficient of heat expansion. The sharp increase in the expansion of these two due to the transformation of α and β quartz at 575 degrees C. is to be noted. Basalt and granulated blast furnace slag, on the other hand, show a distinctly small and continuous coefficient of heat expansion up to 800 degrees C.

(c) Cement and Concrete Mixtures

In order to determine the combined action of hardened cement and the aggregates, cement mixtures in the ratio of 1:3 with ordinary standard quartz sand and basalt sand aged in air were tested similarly after two months for their coefficient of heat expansion. Figure 8 represents the curve. The sudden change and the absolute magnitude of the coefficient of heat expansion of the quartz mixture as compared to the basalt mixture is obvious. After the heating, both samples were weak, which is to be ascribed to the loss of water from the cement. In co-operation with the firm of Dücker of Dusseldorf, I had an opportunity to test three different basalt concrete mixtures which were to be used for a coke quenching tower of a gas plant and to determine their coefficient of heat expansion up to 800 degrees C. The curves for the heat expansion were very similar to those for the cement mixture with basalt sand in the ratio of 1:3. In collaboration with the Dücker firm, I will report on these tests separately.

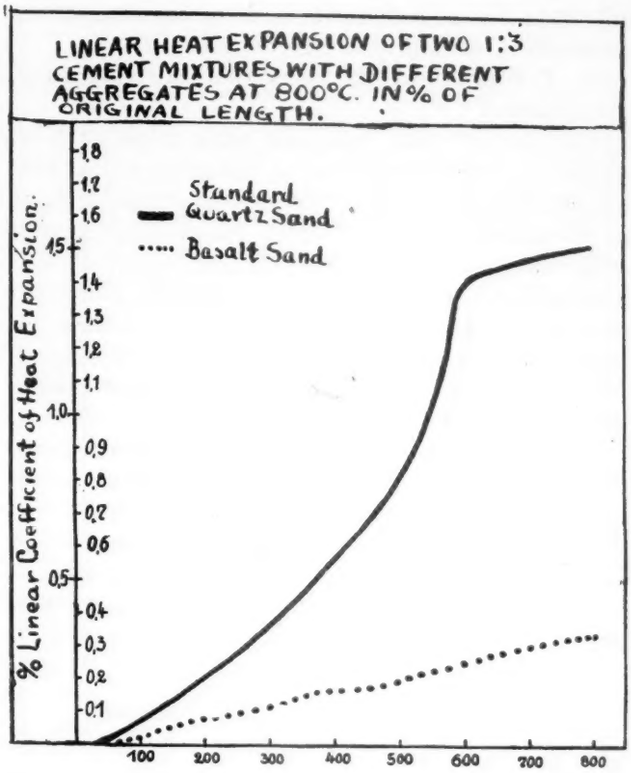


Fig. 8

Results

So far as the few experiments which are the subject of the present report can determine, I may draw the following conclusions:

1. Hardened neat Portland cement shrinks more or less strongly on exposures to temperatures above 200 degrees C. The shrinkage depends partially on the continuous loss of absorptively or zeolitically held water. As the structure of dried gels or the space lattice of zeolites is not disturbed by loss of water, there is consequently no necessity for the appearance of a loss in mechanical strength in the hardened cement.

2. Of more importance for the mechanical strength seems to be the sudden loss of the loosely held water of 100 degrees and the loss of water crystallization at 530 degrees as a result of the decomposition of calcium hydroxide.

3. Of the aggregates the quartzitic show high coefficients of heat expansion and besides that the effect of the α and β quartz transformation at 575 degrees accompanied by a linear heat expansion effect amounting to one-half per cent. Basalt and blast furnace slag, on the other hand, show a small and uniform coefficient of heat expansion.

4. Mixtures of cement and quartz sand of 1:3, as well as basalt concrete, show the same strong differences of heat expansion as the pure aggregates. The shrinkage of the cement as binding medium does not enter into the phenomenon. According to the results with the small test samples,

all these heated samples showed a complete loss of mechanical strength at 800 degrees C.

5. For practical purposes the following is of importance:

For temperature resisting structures such as chimneys, waste heat boilers, coke-quenching towers, etc., quartzitic aggregates such as quartz sand or granite should not be used. Instead, aggregates with smaller and more uniform coefficients of heat expansion are to be used, such as basalt, blast furnace slag and probably also limestone which expands but little and uniformly up to its decomposition temperature of 900 degrees C. Measurements will be made on this.

For my further experiments, indications from the point of view of Portland cement manufacturers and concrete contractors are desired. Due to the many-sidedness of the problem considered, I desire the posting of exact questions. By the application to actual examples the utility of my investigation for technology will be increased.

Annual Fire Loss Enormous

Some statistics and illustrations will aid in visualizing just how enormous and stupendous is the total annual fire loss in this country, especially in rural communities. The yearly fire loss in the United States and Canada is so great that it would build nearly two Panama Canals; it would pay the cost of the American postal service; it would meet the salary of practically every school teacher in the United States. For the five year period from 1919 to 1923 statistics of the Actuarial Bureau of the National Board of Fire Underwriters show that the average daily loss on farms alone due to fire, was $77,346. The total loss for the five-year period amounted to over $141,000,000. One farm in every thirty-two suffered more or less loss. On an average there is a farm fire somewhere in the United States every fifteen minutes and each day ninety-six farm buildings are destroyed by flames. Staggering as is this national property loss due to fire, it does not of course, include the loss of life. Last year 15,000 Americans were killed and 16,000 injured severely in fires. This human toll is about twice that of ten years ago.

Edison Cement Company Educates Foreign Born

The Edison Portland Cement Company at New Village, New Jersey, has established a school, with three teachers, to teach foreign born employees of the company and others who desire to attend, the fundamentals of government, reading, writing and arithmetic.

One of the primary objects of this education is to prepare the employees for obtaining naturalization papers. The company will bear the expense incurred by this service.

Earle C. Bacon Figured Prominently In Consolidated Company Plant

Earle C. Bacon, Incorporated, designed and furnished all the conveyors for the plant of the Consolidated Stone and Sand Company at Upper Montclair, New Jersey, which was described in the November 24, number of Pit and Quarry. The first scalping screen in this plant is 58 inches in diameter and 26 feet long. It is entirely of manganese steel and was also designed and furnished by Earle C. Bacon, Incorporated. The Farrel crushers referred to in the article as 26 by 10 inches are in fact 36 by 10 inches.

Earle C. Bacon, Incorporated, designed, made the drawings and furnished all the equipment for the new addition to the plant of the Consolidated Stone and Sand Company to go with the 60 by 42 inch Farrel crusher. The other equipment already on hand has been utilized for the balance of the plant.

Reduced Fares to Cincinnati

The National Sand and Gravel Association has arranged, through the various railroad passenger associations of the country, for the use of the certificate plan in connection with attendance at their annual convention. The effect of this certificate plan is to give all who attend the convention a reduction of one-half the regular return fare to their homes from Cincinnati, provided, 250 certificates can be secured and presented to the agent of the railroads at Cincinnati for validation.

Tickets at the regular one-way passenger rates on the journey to Cincinnati may be obtained from passenger agents on any of the following dates: January 13, 14, 15, 16, 17, 18, and 19. Upon request, the passenger agent will give you a certificate, but he will not do so unless he is asked. It is suggested that you present yourself at the railroad station for tickets and certificates at least 30 minutes before departure of train on which you will travel to Cincinnati, in order to give the agent plenty of time to fill out the certificates.

Certificates are not kept at all stations. If you inquire at your home station, you can find out whether certificates and through tickets can be obtained to Cincinnati. If not obtainable at your home station, the agent will inform you at what station they can be obtained. You should, in such case, purchase a local ticket to the station which has certificates in stock, where you can purchase a through ticket to Cincinnati and, at the same time, ask for and obtain a certificate.

Immediately upon your arrival at the convention headquarters in Cincinnati, you should present your certificate at the convention registration desk for validation. This is necessary before you can use your certificate to secure the reduced rate for the return journey.

THIS LIME COMPANY BALANCES OPERATIONS WITH SURROUNDING CONDITIONS

By F. A. Westbrook

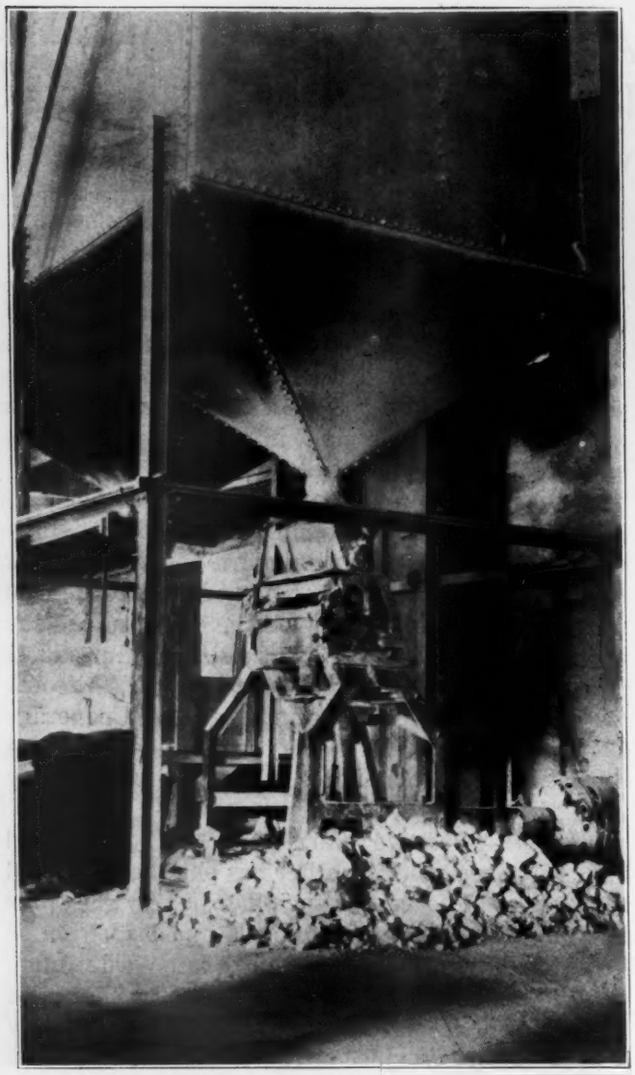
THE Berkshire Hills Lime Company has been in operation for so many years that the second generation of inhabitants of the company's village are now working in the plant and some of the third generation will be there before long. In fact the human side of this undertaking is so interesting that I cannot pass over it without a few words before telling the technical part. Mr. M. F. McCarthy is superintendent and has held this job for twenty-four years. He told that this company has a village of fourteen comfortable houses, close to the kilns where practically the entire force lives. There is also a school house with two teachers and fifty-four pupils and some of the men working at the plant were born in this village.

The plant is located about a half mile from the main motor highway running between Canaan, Connecticut, and Great Barrington, Massachusetts, and is in the midst of thickly wooded hills. This makes it comparatively simple to obtain a supply of wood to burn in the kilns. This matter of obtaining wood is a great boon to the farmers of the neighborhood because during the winter, when their other work is slack, they cut and draw in the year's supply for the plant. Something like five thousand cords of wood are used at the plant each year. Of course this makes it possible for the farmers to remain profitably employed the year round. It is a very good example of what is meant by "obtaining a proper balance between industry and agriculture so that they will be supplementary rather than rival enterprises," as Dr. Glenn Frank, President of the University of Wisconsin, expresses it. It is easy to see that this industry with its village, located in a farming region, creates conditions by which the farmers may profit in more ways than one; also the presence of the farm is a great help to the lime plant in producing the necessary wood supply and food.

The Berkshire division of the New Haven railroad passes within a half mile of the kilns. However, instead of having a standard gauge siding for this distance the Lime Company has extended its narrow gauge tracks, between the quarries and the kilns, to the railroad and hauls its finished products down to the loading points by means of Whitcomb gasoline locomotives. The International Cooperage Company has a barrel factory at this loading point so that it is a simple matter to obtain this necessary item of supplies.

This plant has two quarries: One is 24 years old and quite deep, and the other has only been worked for five or six years. In the older quarry the stone is being taken out on two levels and loaded on to home made cars or Koppel or Easton side dump cars. These are hauled up an incline by means of an O. K. Clutch and Machine Company electrically driven hoist, provided with a Roebling Yellow Strand wire rope. Two Goulds electrically driven centrifugal pumps are employed to keep this quarry

Part of Working Face at New Quarry



Portable Scales Under Ground Bins

Locomotive and Cars for Handling

dry, which would otherwise fill very rapidly.

From the older quarry the narrow gauge tracks extend directly into the newer quarry, which is in a side hill and therefore requires no incline. Although quantities of water enter this quarry it drains away naturally. Koppel switches and tracks are used in the quarry.

Drilling is done by three BC-430 Ingersoll-Rand drills for both the blocks and larger holes. For blasting 30 per cent Du Pont gelatin dynamite is used. An Ingersoll-Rand compressor is located at the top of the older quarry to supply air for drilling in both quarries, the distance between the two being less than one-quarter mile.

State road construction within easy trucking distance of this operation has done a good deal to reduce the overhead expense frequently resulting from inferior stone which has to be taken out of the quarries but which is not suitable for burning.

Looking Down Into Quarry

Wood Storage

This, otherwise waste material, makes very good foundation stone for improved highways without much additional breaking up and considerable quantities are now being sold for this purpose. It is a very fortunate situation and it will be seen that a good deal has been accomplished here in eliminating waste in such directions as local conditions have made it possible.

The plant has five kilns, made by the Coatsville Boiler Works, which are housed in a building having corrugated and galvanized iron sides and roof. The limestone is dumped in at the top of the kilns from a series of trestles having tracks which branch off from the main line coming from the quarry. At the center of the drawing floor is a Williams hammer mill for grinding the burned stone and a short ramp leads up to the grinder so that the material may be taken up and dumped in by wheelbarrows. Alongside the crusher is a Sturtevant elevator which carries the ground material to two 20-ton steel overhead bins which were made by the Sturtevant Company.

Firing Floor of Kilns

Tracks and Trestles to Top of Kilns

Loading Side of Kiln House

A Sonander automatic scale is placed under the spout of one of these bins and is equipped with casters so that it may be readily pushed under either one or the other spout and thus provides a convenient labor saving device for filling containers with ground unslacked lime. There is no hydrating equipment at the plant.

In addition to this scale there is also a Fairbanks platform scale in front of each kiln for use in barrelling lime, as it is drawn from the fire, with only the usual amount of hand breaking. Pieces which are picked out as unsuitable for barrelling are taken to the grinder and reduced thus eliminating a great deal of waste. In fact the installation of the crusher equipment is an important step in increasing the profitable operation of this plant and, as a strategic move to avoid waste so urgently recommended by Mr. Hoover, it might well commend itself to the serious consideration of many other lime producers. Badger's fire extinguishers are located at several convenient points around the firing and lime drawing floors as a preventative measure.

All shipments are made in barrels which are loaded on to small flat cars and hauled by the steam locomotive to the railroad. The output is about 85,000 barrels of 250 pounds each per year.

Indiana Limestone to Offer Stock to Employees Next Year

According to an official statement made public recently, the Indiana Limestone Company will announce a plan for the offering of stock to employees about the first of the year. This course is in line with the policy of the management to give workers a share in the ownership of the business. Details of the plan are now being worked out, but the payment of a good portion of subscriptions by the company is assured. Three years will probably be allowed for the payment of stock subscribed by employees. Mr. A. E. Dickinson, president of the company, announced the project after he had made a study of the employee stock ownership programs of the companies throughout the country where this feature is prominent.

Grinder and Elevator

DEVELOPMENT OF IMPROVED HIGHWAYS

By T. H. MacDonald and H. B. Fairbank*

OF THE 3,002,916 miles of highways of all classes in the United States, approximately 448,000 miles were improved with some form of surfacing at the close of the year 1924, according to the best available estimates. If the last year's work has been as productive as that of 1924, and there is every reason to believe that it has been, the surfaced roads at present aggregate not far from 500,000 miles, about one-sixth of the total mileage.

Accepting the latter figure as reasonably representative of the present condition, it will be convenient hereafter ot deal with the more exact figures of 1924, especially since surveys made by the Office of Public Roads in 1904 and 1914 furnish the statistical basis for the determination of the character and extent for the progress made during the last two decades.

According to these surveys there were 247,291 miles of surfaced roads in 1914, and 153,662 miles in 1904. The net increase during the first of the two decades was, therefore, a little over 100,000 miles, or approximately 10,000 miles a year; and this rate was more than doubled during the second and last decade.

The relative progress made during these two 10-year periods, however, is not expressed fully by the net increases in surfaced mileage. It is safe to say that practically all of the roads that were surfaced in 1904 have since been resurfaced and undoubtedly a considerable percentage of the 257,291 miles surfaced in 1914 has also been replaced with new, better and wider surfaces since that date. The real measure of the progress made during the last decade is, therefore, not the net increase of more than 211,000 miles but a figure which much more nearly approaches the total of improved mileage at the close of the period.

The true extent of the change becomes apparent when we examine the character of the roads classified as surfaced at the three survey periods. Of the 153,662 miles surfaced in 1904 only 141 miles, or less than one-tenth of one per cent of the total, were improved with a surface better than waterbound macadam. By 1914 the mileage of this class of roads had increased to 14,830 or 5.8 per cent of the total mileage then surfaced; but more than two-thirds of the roads so classed were surfaced with bituminous macadam and surface-treated waterbound macadam, the least durable of the types included in the class. The increase in the mileage of high types to a total of 89,771 miles between 1914 and 1924 is, therefore, more remarkable in view of the fact that the surface-treated and bituminous macadam roads constituted in the latter year less than half of the total mileage of the class, which as a whole represented more than 19 per cent of the total surfaced mileage. More than 45,000 miles in 1924 were paved with concrete, brick, bituminous concrete or equivalent types; and the average width and strength of all surfaces included in the high-type class were doubtless considerably greater than in the earlier years.

In 1904 there were 38,622 miles of waterbound macadam roads—practically 25 per cent of the total surfaced mileage. By 1914 the mileage of this type had increased to 64,898, but the percentage of the total mileage remained practically unchanged at 25 per cent; and in the last decade both the mileage and the percentage diminished, the former to 60,235 miles and the latter to 12.9 per cent, a relative decrease of nearly 50 per cent.

In all three years the roads surfaced with gravel and other low types of surfaces constituted the bulk of the surfaced mileage, but whereas in 1904 they constituted practically three-quarters of the total, in 1924 they represented only a little more than two-thirds. The mileage of these types in 1904 was 114,899; in 1914 it was 177,563; and in 1924 there were 317,960 miles.

These changes in the character of the surface mileage during the two decades are shown more clearly in the table given at the bottom of this page.

Class of Surface	Year 1904		1914		1924	
	Miles	Pct.	Miles	Pct.	Miles	Pct.
Gravel and other low types..	114,899	74.7	177,563	69.1	317,960	67.9
Waterbound macadam	38,622	25.2	64,898	25.1	60,235	12.9
Surfaces better than waterbound macadam	141	0.1	14,830	5.8	89,711	19.2
Total	153,622	100.0	257,291	100.0	467,906	100.0

The year 1904 marks the end of a period. Up to that time there had been no important change in the methods of road construction which had been employed for a century or more. The major types of surfacing were gravel and macadam, and either was known to give entire satisfaction under the traffic normal to the country roads of the time. Other types had been developed and used in small mileage, such as the shell roads of the tidewater States and the sand-clay roads of the South, but the element of availability was the determining factor in the choice of such materials rather than any difference in the demands of traffic; and the same element in fact, largely determined the choice of the two major types.

Thus we find that there was preponderance of gravel roads in Michigan, Indiana, Illinois, Iowa, Wisconsin, Minnesota and the Dakotas where gravel deposits were plentiful; and a preference for stone in Kentucky, West Virginia and others where suitable gravels were scarce. From New

*A paper read at the convocation of the Western Society of Engineers.

Jersey south, the Atlantic and Gulf States had built rather considerable mileages of oyster shell roads; and the Southern States in which there was a scarcity of other materials had developed the sand-clay type. Even the small mileage of high-type surfaces which had been constructed was doubtless attributable less to traffic demands, than to the availability of the material, for of the total of 141 miles we find that 123 were paved with brick, and 104 were in the two states of Ohio and West Virginia where brick was cheap and perhaps the most available local material.

Viewed broadly the few types of surface constructed up to this time may all be considered as of one class. In the construction of all the same principles governed; in all a fragmental mass was bound together more or less firmly by a natural cement in the manner made familiar by a century of practice, and all alike depended for their efficiency upon the conic principle of pressure transmission by which they spread the vehicular loads and thus reduced the intensity of pressure borne by the subgrade.

That need was felt for no other kind of construction was due, of course, to the fact that the traffic on all roads was much the same. Even in the more populous states the greater part of the traffic using the roads consisted of relatively light horse-drawn, steel-tired vehicles, to which were added near the cities a bicycle traffic which, though it might attain considerable volume, was never more than a negligible factor in determining the type of surface. This was the normal traffic condition which existed practically up to 1904. What makes that year a turning point in highway history is the fact that about that time there began the great outpouring of motor vehicles from the cities which quickly set the intercity roads apart from others as a class requiring different treatment. The peculiar effect of the automobile on waterbound macadam roads is so well known as to require no description and the manner in which the road builders met the challenge by substituting tars and asphalts for the weaker mineral binders has been an oft-told tale. First as dust layers then as protective surface coatings, then as binders introduced into roads of the macadam type by penetration, and finally as hot admixtures according to the bituminous concrete principles, these materials, borrowed from the stock in trade of the city street builder, solved the automobile problem in a manner which was apparently entirely satisfactory.

The effect of this development in the road building art is shown by comparison of the statistics of 1904 and 1914, the dates which, to all intents and purposes, mark the beginning and crest of the wave of bituminous construction. In 1904, according to the records, there were in the entire country only 18 miles of bituminous rural roads, all in the two states of Massachusetts and Ohio. By 1914 there were 10,500 miles, a mileage which was nearly three-quarters of the aggregate length of all roads of higher type than macadam. This was the high-water mark of the lower forms of the bituminous types. That it by no means marked the end of their usefulness is indicicated by the fact that 3,367 miles of the surface-treated and penetration types were built in 1924. The recession of the tide is indicated, however, by the fact that the mileage of the two types existing in 1924 was less than 50 per cent of the mileage of all types better than water-bound macadam in comparison with the 75 per cent level reached in 1914.

It is generally recognized that these two types which came into use with the development of passenger automobile traffic are especially adapted to that class of traffic. The relative decline in their use began when motor trucks in considerable numbers began to appear on the rural highways; and coincidentally we find an increasing swing toward the rigid pavements of concrete and brick and bituminous concrete on a concrete base. The turning point was reached in 1914 or perhaps a year or two earlier.

The first concrete pavement was built at Bellefontaine, Ohio, in 1893, but up to 1909 no more than 5 miles had been constructed on rural highways in the entire country. In that year approximately 4 miles were built; in 1910 about 20 miles were added, the following year 40 miles, and then the first big increase occurred in 1912 when more than 250 miles of rural highways were paved, to be followed in 1913 with 500 and in 1914 with more than 1,500 miles. At the close of the latter year there were in the entire country 2,384 miles; and 10 years later the mileage had increased to 31,146 and construction was proceeding at the rate of more than 6,000 miles a year, a rate approached by no other type better than gravel.

The more extensive use of brick and the bituminous pavements of the mixed type on concrete base began also at about the same time and was due to the same cause—the increased use of motor trucks. In 1914 there were approximately 1,600 miles of brick pavement; in 1924 there were 4,319. In 1914 the mileage of rural highways paved with bituminous concrete or sheet asphalt was still negligible; in 1924 there were more than 9,700 miles of these types.

The first of the two decades we have had under consideration was marked not only by the development of new types of road, but also by two other changes of even greater significance. The first of these was a general increase in the radius of travel by highway occasioned by the use of the automobile; and the second—a natural result of the first—was a change in the character of the public demand for highway improvement.

In 1904 the automobile had still to prove its ability for sustained performance. Its ownership

was still limited to a small and wealthy class. The popular demand for improved roads was, therefore, still predicated upon the use of the bicycle and the horse-drawn vehicle. The farmers, always conservative, were still, for the most part, either actively hostile to road improvement or lukewarm in support of it. In general their demand was for the improvement of the roads connecting their farms with the railroad shipping points or nearby towns. More positive influence was exerted by city and town merchants who sought by road improvements to extend the trading radius and business of their towns and by the limited but influential class of motorists who longed for smoother, mud-and-dust-free roads upon which to operate their vehicles. All these influences combined at first to produce a demand for short stretches of improved roads radiating from the towns and rail shipping points. Later, as the automobile was perfected and its users became more numerous, the latter created a demand for longer, unbroken stretches of improved roads, forming a network connecting the larger towns, a claim that was resisted by the farmers who continued to favor the so-called farm-market type of improvement.

In the smaller Eastern States the conflict never became acute, largely because the distance between towns and market points was so short that the farm-to-market plan of improvement when carried to its ultimate development became practically identical with the inter-town or trunk-line plan. Thus we find the issue satisfactorily settled in Rhode Island as early as 1902 by the adoption of a definite system of State highways for construction by the State Board of Public Roads. A similar proposal by the highway commissioner of Connecticut, made originally in 1906, was enacted into law by the State legislature in 1913; and in the meantime Maryland had settled the question definitely by the adoption of an inter-county seat trunk-line system to be improved and maintained in its entirety with State funds under the State Roads commission. Maryland's system was designated in 1908 and was the first to be placed completely under State control for both construction and maintenance.

That the controversy was not so quickly settled in many of the other states was due mainly to two reasons. First, the important lines of travel in a number of states were not sharply defined. This resulted in some sparsity of settlement, and in others from the contrary condition of close settlement, with numerous centers of more or less uniform size and importance. States such as Texas and Wyoming were typical of the first group. In them the long distances between centers and the condition of the roads delayed the development of highway traffic between the towns and promoted a use of the highways largely as feeders to the rail lines; and the same remoteness of the towns one from another prevented the early harmonizing of the two plans of development as in the smaller Eastern States by the evolution of one into the other. Of the second class there were such states as Iowa, Kansas and Wisconsin, in which the very number and uniform size of the town centers caused a diffusion of traffic over many roads and delayed the recognition of routes of outstanding importance. In these states also the towns are essentially agricultural centers and this fact contributed further strength to the demand for farm-to-market roads as opposed to trunk lines.

The instances mentioned furnish examples of one of the reasons for the prolongation of the controversy which raged over the question of farm-to-market vs. trunk-line development. The second reason was simply that many of these states as yet had no state agency for the administration of a highway plan of statewide scope, and the development of the trunk-line plan naturally presupposes the existence of such an agency.

The second of these reasons was promptly removed after the passage of the Federal Aid road act in 1916 by the provision of that act requiring the creation of adequate highway departments in all States as a condition precedent to participation in the benefits of the Federal aid. And a first step toward the ultimate settlement of the trunk-line question in all states was made when the Bureau of Public Roads as one of its first administrative acts requested of all states the submission of a 5-year program map showing the system of roads upon which the State highway departments would request Federal aid during the period covered by the appropriations provided by the first act of Congress. Although the systems designated in response to this request were understood to be merely tentative the request of the Bureau had the effect of directing attention—in many states for the first time—to the desirability of establishing a definite program for the improvement of a system of highways as distinguished from the more or less casual improvement of unrelated sections of roads.

The Federal aid work had scarcely begun, however, when the war intervened and practically put a stop to all operations; and the war did a number of other things to the existing improved roads which, however disastrous they may have appeared at the time, have turned out to be blessings in disguise. At the outset the construction and maintenance of highways were declared to constitute a non-essential industry. As a consequence new construction, except as required for the immediate service of the army, was greatly curtailed. This result is reffected in the records which show in 1916 —the year before America's entrance—a construction of the roads under the supervision of the State highway departments amounting to 16,160 miles; a decline to 11,996 and 11,944 miles respectively in 1917 and 1918; and a return to 18,260 miles in 1919. Maintenance also was greatly hampered by

the difficulty of obtaining the necessary materials and the scarcity and high wages of labor. At the same time there was released upon roads generally inadequate to stand it an unprecedented traffic of heavy motor trucks. To this experience and the heavy damage which followed we owe the development of most of the sound principles and policies which now govern the improvement of highways.

The first result was a strong reaction against the use of heavy motor trucks. There were large numbers of people who, forgetting that a road is of service only in so far as it accommodates the need for economical transportation, demanded that the manufacture and operation of vehicles too heavy for the existing roads be prohibited. As few of the roads were designed to carry motor truck traffic, to have taken this course would have amounted to the throttling of a new development in transportation before it had a chance to demonstrate its utility, and it was rightly opposed with great energy by the manufacturers of motor vehicles. The latter, on the other hand, took a position at the opposite extreme from which they demanded the right to manufacture and sell heavy vehicles of large capacity, without regard to the strength of the roads, on the theory that the greater the capacity of the vehicle the smaller would be the cost of operation per unit of capacity. Their slogan was "build the roads to carry loads," and this was met by the opposite party with the equally dogmatic demand that the loads should be limited to the capacity of the existing roads.

The issue thus joined, the pricipals to the controversy highway officials on the one side and the manufacturers on the other wisely agreed to submit their difference to the test of mutual discussion; and out of the series of conferences which ensued there came an agreement upon certain fundamental facts and principles which have served as the basis for a harmonious cooperation of the two groups, and which now constitute the foundations of highway improvement policy in all states.

It was agreed at the outset that for the first time in history the weight of vehicles had become a critical factor in rural highway design. Hitherto the minimum practical thickness of road metal had been sufficient to carry the maximum vehicular load. The development of the motor truck had altered this situation. It called for stronger surfaces that would spread its heavier load over a wider area of the subgrade in order to reduce the intensity of the pressure to an amount which the soil would support.

It was clear also that whereas deterioration of the highways had previously resulted mainly from the stirition of the surface, a new form of deterioration approaching rapid destruction would result unless the roads upon which the heavier motor trucks were being operated were strengthened so as to enable them to carry the increased weights. And whereas, the amount of the deterioration had formerly been a function of the volume of the traffic and of time, the new destruction by excessive weight might be caused by a few vehicles in a very short time.

It was agreed, therefore, that the highway officials must have definite knowledge of the maximum weight to be supported as a first condition of design; and this knowledge was supplied, in a measure, by the voluntary decision of the manufacturers to limit to 7½ tons capacity the future production of vehicles. Engineers were thus assured that if, in the reconstruction of the thoroughfares upon which heavy trucking had developed, they would design to accommodate a vehicle of 7½ tons capacity they would not see their handiwork quickly destroyed by vehicles of much greater size and weight.

But this alone was not a sufficient basis for the design of all roads. The building of roads of sufficient strength to carry 7½-ton trucks require a heavy investment of public funds, which could be justified only if the economies inherent in the transportation of goods in vehicles of large capacity were sufficient to outweigh the increased cost of the roads. It was recognized clearly for the first time that the cost of highway transportation is made up of the cost of the highways and the cost of operating the vehicles over the highways, and it was agreed that the common purpose of the public highway officials, vehicle manufacturers and operators should be to reduce the total cost of transportation rather than one or the other of the elemental costs. It could be proved that the number of large-capacity trucks already using some of the highways—principally those radiating from and connecting the larger cities—had already grown to the point where the combined savings in operating cost would more than balance the greater cost of providing highway service for them. As to these highways there could be little doubt of the wisdom and economy of the heavy truck traffic. Other roads, similarly located with respect to cities, had not yet developed a sufficient amount of heavy traffic to repay the additional cost of the stronger construction, but it was not difficult to foresee that such a condition would develop in the future. On the majority of the roads, however, the development of traffic of sufficient weight to justify the higher types of construction was very remote; and it was apparent that the one-time prevailing condition of uniformity of traffic on all roads had been definitely broken down. Instead, a new and much different condition had arisen under which the main inter-city roads were found to be carrying traffic far in excess of the much greater mileage of local roads.

Under the new condition the economic justification for the improvement of the main roads lay to a far greater extent than formerly in the reduc-

tion of transportation costs and to a lesser degree in the effect upon the value of property. The main roads had become through traffic arteries, as distinguished from the more numerous local roads which continued to be of value primarily through the service they render in giving access to the land.

As to the main roads, which carried a wide-ranging traffic, it was now clearly apparent that the character of their improvement must be commensurate with the density of their traffic; that continuity of improvement was of the highest importance; and that the traffic was already so great that the loss in operation of vehicles in the absence of road improvement would exceed the cost of improvement. These roads also were distinguished in one other respect, namely, that their traffic tended to increase far more rapidly than that which was to be found on the local roads, the condition of which remained much as it had been. Where the main roads carried long distance traffic, the local roads served the traffic of a neighborhood; where the main roads were collectors of traffic, the local roads were feeders and distributors; where the traffic of the main roads tended to grow in direct proportion to the growing use of motor vehicles and the growing resort of industry and the entire people to highway transportation, the local roads served the much lighter, and, from the standpoint of growth, far more stable traffic produced by a single agricultural community.

It became apparent, therefore, that the economic justification of local road improvement would continue to rest largely in the value and importance of the land; that, in the main, the traffic would demand only a low type of improvement; and that continuity of the improvement was not so essential as in the case of the main through roads.

The need of continuity in the improvement of the main roads was the first of the new conditions to be met with appropriate action. From 1915 on, all states in rapid succession designated systems of state roads, including generally the main inter-city roads, to be improved under the more or less direct supervision of the state highway department; and the several State systems were substantially welded into a national network by the designation in 1921 of the Federal aid highway system which, though not quite co-extensive with the State systems is practically co-incident with them throughout its extent. Continuity of improvement of the main roads thus assured it remained for a joint committee representing the American Association of State Highway Officials and the National Automobile Chamber of Commerce to enunciate a policy with respect to the rate and manner of the improvement which could win general support and adoption.

Briefly that policy may be stated as follows. It is accepted as a truism that the volume of traffic on the main roads is so great that the economies in transportation effected by road improvement clearly outweigh the cost of the improvement. This being true the improvement should proceed as rapidly as available supplies of labor and material will permit and without other limit. All roads should be improved to the degree justified by the operating savings that may be expected to accrue to the traffic, and no road should be improved to any greater degree. Where the mileage of road to be improved is so great that the type of improvement indicated by the traffic cannot be completed on the whole mileage within a short period the most important sections should be raised immediately to ultimate type, and the balance of the mileage should be advanced through the initial stages of grading, draining, and low-type surfacing in order to spread as much of the benefit of improvement as quickly as possible over the entire road system, further improvement to await the completion of the first stage over the whole system. This is the practice known as stage-construction and it is the only feasible practice in the numerous States in which a large mileage of main roads remains to be improved on the fact of a traffic already highly developed. It is also the logical plan of development for the main roads of the States in which traffic has not yet grown to the proportions justifying high-type surfacing.

In any case the stage-construction plan takes account of the rapid growth of traffic, which is a characteristic especially of the main roads, by providing fully in the initial stage for the subsequent construction. Grades and alignment are designed to meet ultimate requirements; drainage structures are built of durable materials; rights-of-way of ample width for the future are obtained; and the initial surfacing becomes the sub-base of the second-stage surfacing. Obviously the soundness of the plan is contingent upon the complete and continuous maintenance of each stage of the construction, a kind of maintenance which—thanks to the war experience and the standard established by the Federal Highway Act—practically all States are now prepared to give.

The accepted policy contemplates the improvement of the main roads, to which the above methods are applicable, as a responsibility of the States to be assumed through the agency of the State Highway departments, and financed, in large measure by the revenues derived from the taxation of vehicles and motor fuel. The local roads are viewed as the responsibility of the counties and lesser subdivisions. With a few important exceptions as in the case of Cook County and the vicinity of other large cities, the degree of improvement required does not rise above the lower types of surfacing, the expense of which may be met, as it should be, by taxation of the local land and property.

These, then, are the outstanding developments in highway improvement of the post-war period:

The classification of highways according to traffic density; the designation of State highway systems in all States, the systems including the heavy traffic highways of State-wide importance; the interconnection of the State systems by means of the Federal aid system; the improvement of roads in accordance with traffic demands to the limit set by probable operating savings; the stage-construction plan of progressive improvement of entire systems; and the development of adequate maintenance provisions.

One other great advance has characterized this period—the application of scientific research to the problem of developing types of construction and methods of administration and finance adequate to meet the demands of the fast growing traffic. In this also the initial impulse came from the Federal government and, in cooperation with State highway departments and universities, it is continuing to support numerous studies in several fields, as a result of which there is being built up gradually the structure of a new science—the science of highway engineering.

The investigations include studies of the characteristics of materials—sand, stone, gravel, bituminous materials, cement, concrete and brick; determination of the forces applied to road surfaces by standing and moving vehicles; of stresses developed in the structure of roads and bridges by live loads, and by temperature and other natural causes; analyses of subgrade soils and tests of methods designed for their improvement; studies of the flow of water through drainage structures, of the run-off from drainage areas, of the effect of moisture on soils, and many others of fundamental importance and value.

Popular interest has centered upon the large scale tests such as those of the Bates Road, for which entire credit is due the Illinois department, the Pittsburg (Calif.) experiments, the impact tests at Arlington, Virginia, and the intensive studies of highway traffic conducted by the Bureau of Public Roads in cooperation with the authorities of Connecticut, Maine, Pennsylvania, Ohio, California, Tennessee and Cook County, Illinois.

Much that is of immediate practical benefit has already been derived from these investigations; but, for the most part, they are dedicated to the future. It is not to be expected that their fullest benefits shall be immediately realized. The building of a science is a laborious, a painstaking process, and we are still but laying the groundwork which is not much further advanced than were the foundations of the modern science of medicine and surgery fifty years ago. If fifty years hence the science of highway engineering has been built up to the point now attained by the physicians and surgeons, this effort we are now putting forth will be abundantly repaid, and not too late. For the improvement of highways in the United States is a process which must be continued indefinitely.

It is idle to talk of completion when of the three million miles of our highways less than a fourth have been graded, but a sixth has been surfaced, and a sixtieth paved; when little more than half the mileage of the main State roads has been improved with any kind of surfacing, and there remain on these important arteries thousands of substantial one-way bridges and dangerous railroad grade crossings; when the number of motor vehicles registeres is doubling every fifth year and the traffic with them; when the size of our cities and the magnitude of our industries, and the amount of our material wealth are increasing at an almost unprecedented rate. So long as these conditions continue we shall continue to build and maintain and rebuild our roads.

At the present rate we are surfacing approximately 40,000 miles a year and our annual expenditure approximates a billion dollars. There is no indication of an early reduction in these rates of construction or expenditure, dwarfed as they are by the annual production of a 1,000-mile procession of motor vehicles and an annual expenditure for operation approaching ten billions. As a nation we have set our hand to the economic improvement of our means of highway transportation. It is not a task to be accomplished in a day. It is, and must be a continuous process. There is but one limit which may reasonably be set. It is this. No road should be improved by expenditures of public funds in excess of its earning capacity. The return to the public in the form of economic transportation is the sole measure and justification of the degree of highway improvement.

National Lime Association Changes Headquarters

The National Lime Association announce that effective November 22, the headquarters of the Association will be 927, Fifteenth street, N. W., Washington, D. C. This change of address is due to the steadily increasing demand for detailed information.

This has necessitated expansion of both the field and office staff and a corresponding broadening of the activities of the association, all of which required larger quarters.

Shale Found In North Carolina

One of the most striking mineral developments which has taken place in North Carolina during the past few years has been the discovery and development of several areas of shale and clay in the mountain section and Piedmont plateau. In the mountain section the fine shale and schist suitable for heavy clay products are found around Hot Springs in Madison County, and near Brevard and Hendersonville in Transylvania and Henderson Counties. These are of fine quality and produce beautiful colors.

Wage Payment Method Survey

Facts from a recently completed survey of wage payment methods in forty industries by the technical and industrial research division of The Sherman Corporation, have been tabulated and graphed in the two accompanying illustrations.

The questionnaire method was used principally, in gathering most of the information, although a considerable amount of it was obtained through the industrial clientele of the Sherman company. Three thousand questionnaires were mailed to representative companies in the various classifications. Over a thousand replies—better than a 33 per cent response—were received. This high percentage of response is noteworthy in this day when business executives are being "questionnaired to death." It possibly may be interpreted as an indication of the high degree of current executive interest in the subject of wage methods.

Wage Payment Methods In Industry

	Percent of Employees in Plants Surveyed		
	Straight Time	*Piece Rate*	*Premium or Bonus*
GENERAL AVERAGE (*all industries surveyed*)	**61**	**31**	**8**
1. Agricultural implements	56	42	2
2. Automotive products	17	18	65
3. Bakeries—bread, cake, biscuit	63	30	7
4. Beverages	81	14	5
5. Building materials—brick, clay products, stone, etc.	60	37	3
6. Candy and confectionery	65	32	3
7. Chemical and pharmaceutical	65	18	17
8. Clothing—men's and women's garments, etc.	32	67	1
9. Construction—buildings and public works	100	..	..
10. Dental equipment	52	5	43
11. Dairy products	96	4	..
12. Electrical products and radio	60	39	1
13. Flour and feed	90	5	5
14. Food products	82	10	8
15. Foundries—cast iron, malleable, steel and alloy	55	41	4
16. Furniture	57	38	5
17. Glassware and pottery	55	32	13
18. Hardware, toys and specialties	46	45	9
19. Ice and cold storage	95	5	..
20. Jewelry, watches, clocks and optical instruments	41	54	5
21. Knitwear, hosiery, underwear, etc.	29	67	4
22. Lumber, millwork and wood products	79	6	15
23. Machinery	68	18	14
24. Meat packing—beef, pork, etc.	88	12	..
25. *Metals and metal products	49	27	24
26. Musical instruments	18	75	7
27. Oils, paints, inks, etc.	81	18	1
28. Paper mills	81	7	12
29. Printing, publishing and lithographing	69	7	24
30. Power plant equipment	75	18	7
31. Public utilities—water, gas, electricity, etc.	100	..	..
32. Railway equipment—cars, locomotives, etc.	31	68	1
33. Rubber tires and products	20	80	..
34. Ship building	90	10	..
35. Shoes	22	76	2
36. Stoves, furnaces and radiators	49	46	5
37. Tanneries	69	24	7
38. Textiles—cotton, silk, rayon, wool, etc.	46	33	21
39. Tobacco products	29	71	..
40. Miscellaneous	70	30	..

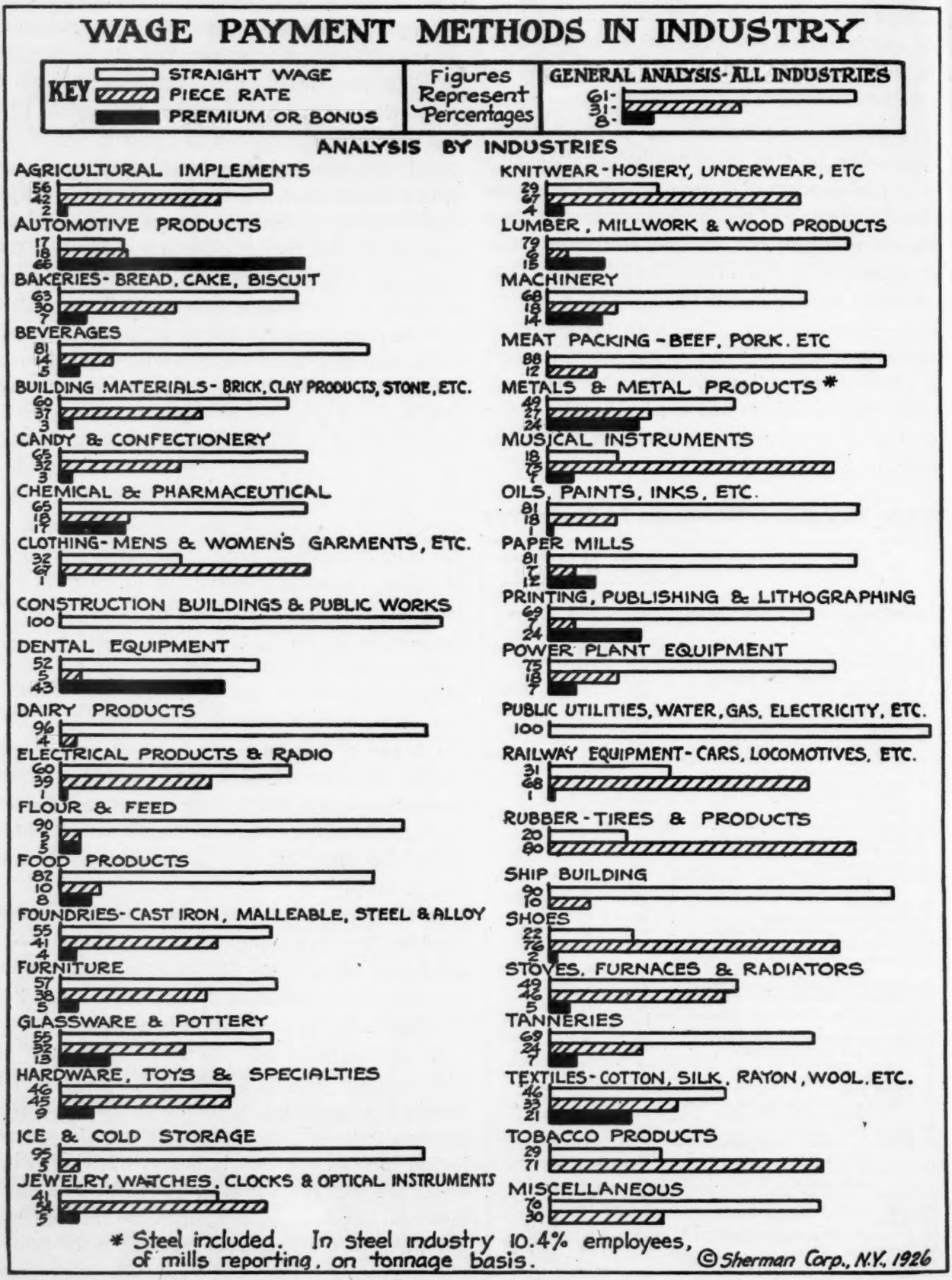
*Steel included. In steel industry 10.4% employees of mills reporting, on tonnage basis.

Over a half million employees are represented in the findings. The percentages of straight time, piece work and premium or bonus methods are percentages of employes and not percentages of plants. There are relatively few plants in which straight time payment is exclusive, although in industries such as Construction and Public Utilities this payment method is the only one in use. But in the plants using some form of wage other than straight time, a great many workers are left untouched by the incentive basis. Number of employees affected by advanced forms of wage payment, exemplified by the individual or group bonus methods, is surprisingly small, only 8 per cent, as will be seen from the figures of general average.

In analyzing the questionnaires, The Sherman Corporation technical and industrial research division included premium or bonus only when it was stated as a systematic part of the wage payment plan and not merely an occasional, opportunistic distribution. It is significant that the Automotive Industry leads in percentage of works on premium or bonus, 65 per cent under some premium or bonus method. Productivity of labor in this industry per man hour has increased over 200 per cent in ten years. Six billion dollars annually in wages are disbursed. The industry's financial structure has grown tremendously. The distribution over a wider and wider population of its product is one of the wonders of the entire business world. It seems logical to conclude that a certain connection exists between the advanced policies and practices in reference to wage payment in the automotive field and the outstanding position of the industry.

In the face of this interesting fact is the high straight time percentage in other industries—61 employees out of every 100 receiving wages without regard to a scientifically developed method of relating output to dollar of wage paid.

In the last published reports of earnings of all corporations—only 60 per cent of them reported profit; the remaining 40 per cent showed losses aggregating over two billion dollars. It seems logical to deduce a certain degree of relation between the fact of predominant straight time wage methods and the profit position of that 40 per cent; and to conclude that industry more generally is needing a means of paying its huge wage disbursements so that incentive will get to work in favor of increased profits through lower costs, as well as increased employe earnings.


WAGE PAYMENT METHODS IN INDUSTRY
KEY
STRAIGHT WAGE
PIECE RATE
PREMIUM OR BONUS
Figures Represent Percentages
GENERAL ANALYSIS - ALL INDUSTRIES
61
31
8
ANALYSIS BY INDUSTRIES
AGRICULTURAL IMPLEMENTS 56 42 2
AUTOMOTIVE PRODUCTS 17 18 66
BAKERIES - BREAD, CAKE, BISCUIT 63 30 7
BEVERAGES 81 14 5
BUILDING MATERIALS - BRICK, CLAY PRODUCTS, STONE, ETC. 60 37 3
CANDY & CONFECTIONERY 65 32 3
CHEMICAL & PHARMACEUTICAL 65 18 17
CLOTHING - MENS & WOMENS GARMENTS, ETC. 32 67 1
CONSTRUCTION BUILDINGS & PUBLIC WORKS 100
DENTAL EQUIPMENT 52 5 43
DAIRY PRODUCTS 96 4
ELECTRICAL PRODUCTS & RADIO 60 39 1
FLOUR & FEED 90 5 5
FOOD PRODUCTS 82 10 8
FOUNDRIES - CAST IRON, MALLEABLE, STEEL & ALLOY 55 41 4
FURNITURE 57 38 5
GLASSWARE & POTTERY 55 32 13
HARDWARE, TOYS & SPECIALTIES 46 45 9
ICE & COLD STORAGE 95 5
JEWELRY, WATCHES, CLOCKS & OPTICAL INSTRUMENTS 41 54 5
KNITWEAR - HOSIERY, UNDERWEAR, ETC 29 67 4
LUMBER, MILLWORK & WOOD PRODUCTS 79 6 15
MACHINERY 68 18 14
MEAT PACKING - BEEF, PORK, ETC 88 12
METALS & METAL PRODUCTS * 49 27 24
MUSICAL INSTRUMENTS 18 75 7
OILS, PAINTS, INKS, ETC. 81 18 1
PAPER MILLS 81 7 12
PRINTING, PUBLISHING & LITHOGRAPHING 69 7 24
POWER PLANT EQUIPMENT 75 18 7
PUBLIC UTILITIES, WATER, GAS, ELECTRICITY, ETC. 100
RAILWAY EQUIPMENT - CARS, LOCOMOTIVES, ETC. 31 68 1
RUBBER - TIRES & PRODUCTS 20 80
SHIP BUILDING 90 10
SHOES 22 76 2
STOVES, FURNACES & RADIATORS 49 46 5
TANNERIES 69 24 7
TEXTILES - COTTON, SILK, RAYON, WOOL, ETC. 46 33 21
TOBACCO PRODUCTS 29 71
MISCELLANEOUS 70 30
* Steel included. In steel industry 10.4% employees, of mills reporting, on tonnage basis.
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FREE LIME CONTENT OF HYDRAULIC CEMENT

IT IS known that the destructive action of fire upon concrete depends to some extent on the presence of free lime. The action of fire causes dehydration of the calcium hydroxide and a consequent shrinkage sufficient to cause partial failure, the latter condition being intensified to a bursting action if moisture then comes into contact with the fired cement.

When Portland and other cements set, calcium hydroxide is frequently produced. Crystals of lime are frequently seen in any cavities. Various methods have been proposed to determine the amount of this free lime and two British research workers, F. I. Brady, M. Sc., A. I. C., and F. J. McConnell, have just completed an investigation of these and the results of this investigation have now been published by the British Building Research Board. Generally they found that there is no test entirely free from objection for one cause or another; all the same they consider that three of these tests afford valuable evidence about the condition and probable behaviour of set and unset cements.

In the report, reference is only made to four methods of estimation—two wet and two dry. The wet methods were—the phenol and sugar tests. The dry ones were—Passow's test and the thermal test.

In order to keep the range of each test as wide as possible several different types of cement (set and unset) were employed. These were:—

1. Portland cement—A well-known brand giving good strengths.

2. and 3. Two British Portland-blast furnace cements (mixtures of about 60 per cent, of granulated blast furnace slag with 40 per cent of Portland cement).

4. Slag cement. A French cold-process slag cement.

5. High alumina cement. A French quick-hardening cement.

The first wet test was with phenol, which has the capacity for readily dissolving lime. The cement was mixed with phenol solution and the latter was then extracted and tested for lime. There were ten tests on set Portland cement, and four on the same substance unset. Generally these showed that the larger the quantity of phenol used the larger was the quantity of lime extracted. An excess of phenol sets up a great increase in the decomposition of the cement. The investigators conclude that owing to the great variations produced by different concentrations, phenol in aqueous solution cannot be generally recommended for determining free lime in Portland cement quantitatively.

The next wet test was that carried out with a sugar solution. Sugar solutions exert a strong solvent action on lime, calcium saccharate being formed. In this case also it was found that a higher concentration of solution or the use of a greater quantity of sugar caused increased lime extraction. However, the decomposition of the cement produced by sugar is much less vigorous than when phenol is used and there was found to be less change produced when time, volume and concentration were varied. The sugar method gave determinations that were found to be fairly accurate over the whole range of cements when tested later by the thermal method. Save in the case of unset Portland cement, for which its use cannot therefore be recommended. However, the investigators look upon this method as of value where set cements have to be tested and only small samples of the material are obtainable. It has the advantage of being extremely rapid, taking only 7 to 8 minutes all told.

In Passow's method—the first dry test—samples of 2 gm. in weight were used and were mixed with an equal quantity of ammonium carbonate. The mixture was then heated for about 10 minutes. The whole process was then repeated, after which the carbon dioxide present was determined. In this test extremely high values for free lime were obtained in some cases and the investigators state that an objection that may be justifiably levelled against this method of estimation arises from the fact that it involves heating of the finely ground specimens of cement with a substance that evolves water on heating.

The thermal method is considered to be the most reliable and valuable of all those investigated. It depends upon the fact that when cements are heated to a suitable temperature the calcium hydroxide contained is converted to calcium oxide. The cement is then mixed with water and the calcium oxide can be estimated according to the rise in temperature produced. It is a method, the investigators state, that is particularly valuable in the case of unset or aerated cements for judging the freshness or otherwise of the material, and it is also of great advantage in any cases where only a small percentage of lime is involved.

Messrs. Brady and McConnell state that the great value of this method lies in testing for probable fire resistance. As the amount of free lime is one of the most important factors the test may be carried out at various temperatures to find the amount of quicklime present after heating in each case. By such means a curve can be drawn that will show the intensity of disintegration which will probably take place after exposure to various temperatures. Another advantage—not presented by other test methods—lies in the possibility of determining the degree of aeration of unset cements.

Since the method does not involve the use of aqueous solutions or heated water vapor, there is no danger of hydration proceeding during the test. The hydration that proceeds when ordinary unset cement is mixed with water is slow at ordinary temperatures, and is accompanied by so small an evolution of heat during the first few minutes, that the accuracy of the method is not impaired—save in the case of some defective cements which heat up very quickly on mixing with water. It might be suggested that some of the heat evolution is due to the hydration of calcium aluminates; if this were a source of appreciable error it would naturally show to a greater extent when high alumina cements were being tested, which is not the case. The following figures were obtained in tests on unset cement:—

	Percentage of Calcium Oxide
Portland cement	2.7
Portland blast furnace cement No. 1	3.4
Portland blast furnace cement No. 2	1.7
Slag cement	2.4
High alumina cement.....	0.4

These figures are lower than those for any other tests on unset cement, and are probably much nearer the truth. The cements were all fairly fresh and the lime figures are low. Stale cements may readily be detected by this means, and tests are at present being carried out to find the changes in hydration and carbonation which occur with various methods of storage and aeration, using this test for purposes of comparison with other properties of the cement.

Chicago Banker Predicts Good 1927

Continuance of good business throughout 1927 is predicted by Ralph Van Vechten, president of the State Bank of Chicago. Money is plentiful and a shade easier, and business has a good momentum at the present time. Mr. Van Vechten said:

"The year 1926 was a record breaking year in which, generally speaking, railroad earnings and other corporate earnings in most lines were quite extraordinary. In looking ahead we are prone to expect too much if we compare the new year with the old. On the other hand, there is nothing to justify a pessimistic view. Business, therefore, has a good momentum, which will carry it well into 1927.

"There has been a substantial decline in commodity prices since August, 1925, and this is still going on. If the reverse were true and commodity prices were rising, there would be an increased demand for credit, which would operate to put the brakes on business. A further decline in commodity prices, from the standpoint of volume and sales, would be beneficial but might result in narrower margins of profit. We are on a sound basis and there is no reason to question a continuation of good business well into the coming year."

A. L. Beck and M. H. Hammond Designed Great Lakes Portland Cement Plant

The new plant of the Great Lakes Portland Cement Industry at Buffalo, New York, was discussed in the article entitled "Cement Plant Development," which appeared in the December 8th number of Pit and Quarry. The author of this article stated that the Burrell Engineering and Construction Company designed and built this plant. This is not the case and we hasten to correct the error. Mr. Adam L. Beck and Mr. M. H. Hammond designed and laid out the plant. The Burrell Engineering and Construction Company were the contractors.

Fred Whitmer Considers 1927 Good For Lime Industry

"The outlook for building is very favorable. There is plenty of cash available. Business generally is good. Wages are high and the cash per capita is still increasing. With all these factors considered, there is no serious cause for alarm so far as the building prospects for 1927 are concerned.

"The reduction in taxes should also tend to help the building business. Within the last seven years our country's indebtedness of twenty-six billion dollars has been reduced to nineteen billion. The amount owing this country by European countries is in the neighborhood of eleven billion dollars. The net indebtedness of this country would be approximately eight billion dollars. The financial condition of this country is, therefore, very good, considering the amount of money expended prosecuting the World War.

"One of the chief essentials in life is shelter. People generally have better homes than they had years ago. With the obsolescence of the old homes and the need for additional homes to take care of the growing population, with the good financial condition of this country and earning power of the workers, the writer can see no cause for any great reduction in the progress for next year. Labor is becoming a little more plentiful. The prices of materials are becoming more staple and these factors should also tend to encourage building.

"The demand for Ohio Finishing Lime at the present time, considering the effect of the rainy weather during the past sixty to ninety days, is very good. The writer feels that the volume of proposed construction and work under way which will be carried over into 1927 is qeual to the volume carried over from last year all of which tend to give us a little more than the normal volume of business."

Fred Witmer, President,
Ohio Hydrate & Supply Co.

PIT AND QUARRY FOREIGN DIGEST

Fused Aluminous Cements

The work which concerned partly the preparation and testing of chemically pure fusions of the ternary system CaO — Al_2O_3 SiO_2, and partly with commercial fused products besides crystallographic examination can be summarized as follows: (1) Two fields in triangular coordinates were plotted showing region of fused cements; one field being a long strip starting at the Portland Cement region and extending almost to the Al_2O_3 corner, and an unsymmetrical closed curve inside this long strip which outlines the region of the high-quality fused aluminous cements.

(2) A sharp line between Fused and Portland Cement cannot be drawn.

(3) Slow cooling of the melt gives better results, longer setting period, and higher compression strength, which in the best cases after 28 days water cure was about 1,000 kg. per sq. cm.

(4) Sintering and fusing temperatures of fused aluminous cement differ by only a few degrees. Fluidity occurs at 1,350 to 1,550 degrees C.

(5) The strength of resistance against 15% NaCl, 12% $MgSO_4$ and 10% $KHSO_4$ solutions increases with rising Al_2O_3 content and is generally very high.

(6) The Bauxite used should be as free as possible from silica.

(7) The Fe_2O_3 content of the bauxite can be changed to Fe by a simple fusing appartus employing carbon and CO as heating resistors.

(8) Only a slight improvement of the fused cement can be effected by slight additions of $CaCl_2$, and siliceous materials. Additions of sulphite waste liquor and of sugar causes a complete destruction of this cement.

(9) The dominating crystal phase of the fused cement is the Mono Calcium aluminate CaO Al_2O_3.

(10) During setting which is a strongly exothermic procedure, the formation of tricalcium hydroaluminate takes place. (Berl & Löblein, Zement, Vol. 15, pp. 642-643; 673-677; 696-699; 715-719; 741-745; 759-762 and 783-785.)

Activating Calcium Sulphate

The natural anhydrite and the calcium sulphate obtained by burning gypsum from 400 to 750 degrees C. do not set in water but can be made to do so by the addition of small amounts of other substances such as $KHSO_4$, $NaHSO_4$, CaO $(NH_4)_2$, SO_4 and Na_2SO_4. The ground calcium sulphate containing 0.3% of catalyst sets to a cake with a crushing strength of 70 kg. per sq. cm. (Budinkov, Compt. rend. *183*, 387-388, 1926.)

Blast Furnace Cement

The results of ten-year tests on the tensile strength, crushing strength, and variation in length of mortar and concrete made with blast furnace cement bear out the results obtained for shorter periods, and compare very favorably with those given by Portland cement and iron Portland cement. (Burcharty-Zentr. Bauverwalt, 1926, 241.)

Grain Size of Portland Cement

The sulphates of the clinker and also gypsum, added to regulate the setting time are concentrated in the finest fractions. The grain size of the cement is distinguished otherwise only by loss on ignition, which is greatest in the finest fractions and decreases with increasing grain size. Setting time decreases with increasing fineness. Constancy of volume is increased by fine grinding. The greatest strengths are reached with grain sizes of 19.7 mm. to 36.3 mm. Fine powder with grain size below 7 mm. is decomposed by atmospheric carbon dioxide soon after grinding and therefore, does not give greatest strength. Hydration occurs through the action of moisture on the surface of the grains and its velocity increases with decreasing grain size. Grains less than 15-18 mm. are completely hydrated, all clinker-forming minerals being practically completely changed. Larger grains are only partly hydrated. Alite hydrates appreciably more rapidly than the other clinker-forming materials. Hydration, further, is dependent on the size of the clinker crystals, and a simple crystal of 15 mm. diameter is changed more rapidly than a grain of equal size composed of various clinker-forming materials. (A. Hauenschild-Zement *15*, 453-456, 469-471, 488-492; British Chem. Abs. Vol. *45*, 879.)

Plaster Casts

In casting mold boards or pattern plates for foundries or making other smooth casts from plaster and other material, sand molds are dusted with powdered resin, pitch, or sublimed S and the powder then liquified so it fills the crevices either by solvents or heat. (English Patent 241,773.)

Porous Artificial Stone

Porous concrete is made by mixing a finely divided intimate mixture of lime and silica containing material with water and a gas generating agent, and hardening the resultant porous mass by steam under pressure. The preferred silica containing material is calcined slate or alum shale. A powdered metal such as zinc or aluminium is preferably used to generate gas, but porosity may be obtained by other means, e.g., the use of soaps, or of ice. (English Patent, 258,073.)

Cement Manufacture

In a cement-making process in which liquid slurry is fed to the rotary kiln through an atomizing nozzle, a screen is provided in the slurry tank to prevent the passage of large particles to the nozzle, and means are provided for returning to the kiln, as dry dust, any slurry carried out by the waste gases. The escaping dust collects on the inclined floor of the smoke chamber, and is carried by an elevator to a pipe leading to a point in the kiln immediately in front of the nozzle. Instead of this arrangement the dust may be returned to the kiln with the pulverized fuel used for burning, or it may be collected in a trough below the kiln and be recharged through slots in the kiln wall by shovel devices secured to the outside of the kiln. (English Patent No. 258,199.)

Block Paving

Concrete paving blocks are molded *in situ* in paper, cardboard, asphalt or like containers which are placed on the foundation and left in position after being filled with concrete and rammed down. The containers may be placed apart, the concrete being also rammed into the spaces between the containers. The containers may be square, triangular or cylindrical in form. The concrete may improve in quality from the foundation to the wearing surface. (English Patent No. 258,245.)

Purifying Mineral Substances

Natural or artificial materials, such as rocks, particularly feldspar and silica, are purified by treatment with a mineral acid such as sulphuric acid or a mixture of mineral acids, such as sulphuric and hydrochloric acids, together with an organic acid such as oxalic acid or a salt of such acid, the process being effected in the cold, or with application of heat. (English Patent, 258,246.)

Concrete Mixers

A rotary batch-mixer for concrete is provided with a bucket wheel elevator, at each end of the drum, one of which raises the material to a loading hopper, while the other receives the mixed concrete from a movable discharge chute and raises it to a further chute delivering the concrete from the machine. (English Patent No. 258,293.)

Plastic Cement Compositions

Cement and the like is mixed with a substance containing water of crystallization, and the mixture is submitted to heat and pressure in a mold to hydrate the cement, and the article produced is subsequently heated to a higher temperature with or without the mold. Bitumen, wax, stearine, shellac, sulphur, fillers, coloring matters, etc., may also be added. In an example, 5 parts of powdered bitumen, 8 parts of borax, and 40 parts of cement are mixed together and pressed in a mold at 100 degrees C. The article is then heated to 150-200 degrees C. Other substances containing water of crystallization specified are alkaline silicates solidified with soap or stearine, and the precipitate formed when ammonium carbonate is added to alum. (English Patent No. 258,320.)

Acid Proof Cements

Pulverized silicon is added to plastic compositions containing soluble silicates like the well-known acid proof cements, in order to bring their thermal conductivity nearer to that of the metal to which they are applied. (English Patent No. 258,616.)

Fused Cement

Mixtures of bauxite or other materials which function as acids such as Al_2O_3, Fe_2O_3, SiO_2 or TiO_2 with approximately the equivalent amount of lime are melted together in a rotary furnace in an oxidizing atmosphere. The solidified melt is powdered. The results are excellent through rapidity of setting and attainment of binding strength. (French Patent No. 607,577.)

Commercial Lava Stone

Volcanic rock is ground, sieved, mixed with 15% water glass, the mixture shaped in molds, under pressure in open air at ordinary temperature, or dried in closed vessels at 40-50 degrees C and finally ignited at 800-900 degrees. The ignition may be omitted. (French Patent 608,109.)

Aluminous Cements

Finely powdered mixtures of Bauxite containing iron with not too great amounts of $Ca(OH)_2$ or limestone, for example, 75% Bauxite and 25% $Ca(OH)_2$ are heated in a rotary kiln under the softening point of the mixture, to about 900-1,100 degrees. It is maintained at this temperature 8-12 hours and then ground. The heat of the kiln may be maintained by various fuels such as coal dust, gas, oil, or hot air. The cement has a hydraulic modulus of more than 2. (French Patent 608,162.)

Paving Slabs

A paving block, which may also be used to form "white lines," comprises a block of concrete having a rectangular or cambered block of rubber affixed thereto by headed bolts. The nut may be separate from the bolt and molded into the rubber, or may be integral therewith. In either case the rubber facing with the projecting bolts is placed in the bottom of the mold and the concrete back cast thereto. The concrete embedded stems of the bolts may be serrated similar to rag bolts, while the heads may be rectangular or pyramidal.

Molding Fibro Cement

A process for manufacturing fibrous materials cemented together with Sorel cement, heat being applied, is characterized in that the binding and hardening of the mixture is effected without pressure in molds which are surrounded by a medium such as air, heated to 180 to 220 degrees C., so that there is present a small quantity of the magnesium or zinc chloride or magnesium sulphate solution until the hardening is completed. The mixture of material to be molded is composed, for example, of 100 parts by weight of wood fibre, 300 of calcined magnesia, and 410 of magnesium chloride or sulphate solution at 28 degrees Bé. A molding machine for carrying out the process continuously is described. (Austro-American Magnesite Co., and K. Erdmasm, British Patent 258,713.)

Strengthening Mortars

Large amounts of iron oxide are mixed with mortars to improve them. (W. Kohen, German Patent 432,723.)

Mixing of Slip

A procedure for the mixing of slip by means of air pressure in several mixers placed alongside each other. The air passes from one to the other. By means of an air pressure tank the pressure is boosted when necessary. (G. Polysius, German Patent 433,066.)

Burnt Chalk and Magnesite

MgO and CaO take up some water in air which is not, apparently, combined, as it may be removed in a P_2O_5-Na_2O desiccator. The amount of such moisture for MgO was 1.8 to 2.1 per cent for CaO-0.6 to 0.7 per cent. (A. Stettbacher, Z. angew. Chem. 1926, 39, 1151-1154.)

Furnace for Fused Aluminous Cement

A continuous furnace for producing fused cements consists of a melting chamber of the reverberatory type provided with a water jacket for cooling the walls at places exposed to corrosion. A feeding channel is provided, preferably a vertical furnace of the cupola or waterjacket type, through which the raw materials are delivered and part of the burnt gases is passed. The material in the reverberatory furnace moves down a slope and is heated by flame jets under pressure. The pressure in the furnace is kept above atmospheric by dajustment of the draught and of the flames. Openings are provided for the tapping of the molten slag and are arranged to take out the remaining burnt gases and to permit heating of the feeding channel in case that become clogged. (G. M. J. Dumas—British Patent, 257, 819.)

Grouting with Cement

The strengthening of the foundations of buildings with cement grout is an example of repair work which can be done. The liquid cement grout is pumped through small holes bored into old masonry which is known or suspected to contain voids and to be lacking in strength. The grout is expected to fill the voids and thus consolidate the loose masses of stone into a monolithic whole. In other cases cement grout is pumped below foundations where additional support is needed. The spiking of the colliery shafts by the cementation method is becoming an important operation. The object in this case is to seal the fissures in any water-bearing strata through which a shaft is being sunk so that water can no longer flow through and impede operations. In the boring of oil wells sealing off with cement grout is essential. The latest application on a large scale is the grouting of roads. The road bed is spread with suitably graded stone and rolled dry. Cement grout, or alternatively, dry cement with copious application of water is then brushed into the road surface, which is again rolled. (Anon. Concrete & Const. Eng. Vol. 21, p. 713-715, 1926.)

High Tension Reinforcement

Drawn wire reinforcement, calculated to receive a working stress 25 per cent in excess of that used for mild steel, gave a slab that was actually stronger than that using mild steel reinforcement. (E. S. Andrews, Concrete & Const. Eng. Vol. 21, pp. 723-726, 1926.)

Mortar Sands

The density of a sand is not always a measure of its suitability for use as a mortar. Addition of fine sand to coarse will, it is true, increase both the density and the strength of the mortar produced. But a further addition of pulverized stone will increase the density without increasing the strength of the mortar due to the greatly increased surface area to be covered by the cements. (H. Burchertz, Zement 1926 (8).)

Coloring of Concrete

A solution of dye is used to replace water in mixing cement and concrete. This dye is one which is soluble in water in reduced condition but oxidized during mixing and setting to water-insoluble substance. The particles of cement thus become covered with dye. Suitable shades can be obtained with the use of 0.1-0.6 per cent of color calculated on the dry weight of concrete. (C. J. Goodwin & G. N. White—Chemical Age, 1926, 14 435).

Aluminous Cement

An aluminuos cement clinker which becomes spontaneously pulverized on slow cooling contains at least 25 per cent of alumina and has a silica content between 0.4 to 0.5 of the alumina content, while the lime is 3-3¼ times the silica content. White bauxite and pure limestone may be used as raw materials with a production of a white cement. (U. B. Voisin, British Patent 259, 203.)

Lime

A very active calcium oxide or hydrate is obtained from the calcareous residue produced in generating acetylene from calcium carbide with excess of water, by removal of the water in two stages. First the excess of water is separated and then the uncombined water is completely removed by heating. By raising the temperature of the second stage calcium oxide instead of the hydrate is obtained. The lime thus provided is stated to have a greater porosity, to give a greater hardening effect in making sand-lime bricks and to absorb water and carbon dioxide more rapidly than ordinary lime. (A. Stevenson and Allen—Liversidge, Ltd., British Patents 258, 660 and 258, 661. Diagrams of machinery are attached.)

Plaster Compositions

Natural or artificial anhydrous calcium sulphate is rendered cementitious by the addition of a mixture of an alkali bisulphate with copper or ferrous sulphate. The hardness of the product may be increased adding a small quantity of calcium phosphate. Fillers, such as glass, sand, quartz, pottery waste, marble, pumice, asbestos, heavy spar, corundum, metallic oxides, calcined pyrites, coal, peat, wood shavings and coloring agents may be added. (P. Budnikoff, British Patent 258, 727.)

Testing Methods for Oil Shale and Shale Oil

Information regarding appartus and methods for the testing of oil shale and shale oil, developed by the Bureau of Mines, Department of Commerce, is contained in a manual just issued by the Bureau. In order to study the principles that govern the retorting of oil shales and to test the oils produced, it has been necessary to develop and standardize reliable apparatus and methods for distilling shale, and to adapt to the testing of shale oils some of the methods the Bureau of Mines uses for testing petroleum. The results obtained in tests of oil shale and shale oil depend upon the apparatus and methods used, as well as upon the nature of the shale. Many retorts now used in oil-shale assaying are unreliable and give misleading results. Furthermore, no comprehensive method for the examination of oil shale or shale oil has yet been adopted by the shale industry. Consequently, to assure convenience and accuracy in rapid assays in the laboratory and in field tests and to provide a basis of comparison between assays made by other methods, a standardized retort and standard methods of testing are necessary. The Bureau hopes that this report will supply the information needed.

Although the Bureau of Mines has only begun large-scale experiments with oil shales, and the feasibility of the commercial manufacture of shale-oil products suited to present market requirements has not been demonstrated, there is ample reason to believe that these products will eventually supplement the more commonly used petroleum products and give equally good service. In 1919 the Bureau, in cooperation with the Department of Metallurgical Research, University of Utah, began investigating the oil shales of the United States to obtain detailed information on their value. The States of Colorado and Indiana also cooperated through their State universities, in which research laboratories were organized to assist in carrying on the oil-shale studies planned and directed by the Bureau. As a result of these studies much information is now available concerning laboratory methods of producing the greatest yields of the best products from oil shale.

November Construction Good

The total volume of construction contracts awarded in the 37 states east of the Rocky Mountains during November amounted to $487,012,500, according to F. W. Dodge Corporation. These states include about 91 per cent of the total construction volume of the country. The above figure represented a decline of 6 per cent from October, 1926. However, there was an increase of 3 per cent over November of last year.

Analysis of the November building and engineering record for these states showed the following items of importance: $229,820,900, or per cent of all construction, for residential buildings; $59,657,100, or 12 per cent, for commercial buildings; $50,128,400, or 10 per cent, for public works and utilities; $34,571,800, of 7 per cent, for educational buildings; $24,691,100, or 5 per cent, for social and recreational projects; $9,603,900, or 2 per cent, for hospitals and institutions, and $9,329,800, or 2 per cent, for religious and memorial buildings.

During the first eleven months of 1926 there was $5,812,518,900 worth of new construction started in the 37 states east of the Rocky Mountains, which was an increase of 6 per cent over the amount $5,477,581,100, in the corresponding period of last year. Contemplated construction projects were reported for this territory to the amount of $633,191,300 during November. There were declines of 1 per cent from October of this year and 11 per cent from November 1925.

FIFTH ANNUAL ASPHALT PAVING CONFERENCE

WITH a registered attendance of 708 engineers, public officials, asphalt producers, and paving contractors, the Fifth Annual Asphalt Paving Conference held at the Mayflower Hotel in Washington, D. C., November 8-12 last, was the most largely attended and successful from the standpoint of profitable discussion of all that have been held. This year's meeting, as usual, was under the auspices of the Asphalt Association, and was made doubly important by the fact that the American Society for Municipal Improvements held its thirty-second annual meeting at the same time and place, so that there was ample opportunity for those attending each meting to hear the discussions at the sessions of both organizations. That the Asphalt Paving Conference is growing rapidly in public interest and popularity was evidenced by the increased attendance this year and the exhaustive technical discussions that followed the reading of each paper presented. The attendance at the Washington meeting was nearly double that at the Detroit conference in 1925.

The central theme running through the sessions was that of salvaging old gravel and macadam roads and worn out streets with asphalt surfaces and the paving of the secondary roads of the nation, especially those highways that act as feeders for the railroads and lead to the markets of the world. Accordingly, the conference, near its close, went on record by resolution urging, not only the salvaging of the investment originally made in constructing and maintaining the older highways and streets as a measure of public economy, but the paving of the tributary highways so as to relieve the trunk lines of congestion, and afford the farmer a better means of marketing his produce.

The matter of salvaging the old gravel and macadam highways, as an economic measure, was brought very forcibly to the attention of the conference by United States Senator George H. Moses of New Hompshire, president pro-tempore of the Senate and chairman of the Senate Committee on Post Offices and Post Roads, who addressed a joint meeting of the conference and the American Society for Municipal Improvements on Tuesday afternoon. The latter organization accepted the invitation of The Asphalt Paving Conference to sit jointly with it and hear the distinguished speaker. Senator Moses reviewed road building conditions in his own state and throughout the nation, discussed the heavy cost of modern motor highways and called attention to the fact that there is already a large mileage of highways now more or less obsolete for motor traffic, but in which there are abundant materials already compacted which he believed could be made of use as bases for modern pavements. The Senator's remarks made such a profound impression on the officials and engineers in attendance that a resolution was adopted commending him for his position in this respect, calling attention to the fact that there are types of paving which are readily adaptable to just such a purpose as the Senator had outlined, and urging a wider dissemination of knowledge upon the subject.

Other resolutions adopted urged the promulgation of more effective measures looking to the safety of motorists and pedestrians on the highways, recommending revision of bidding forms and the standardization of information required of bidders on highway contracts, commending the spirit of cooperation that exists between the engineers on the one hand and the contractors and others identified with the asphalt industry on the other, and commending the project of establshing an asphalt paving school under the auspices of The Asphalt Association. The resolutions were reported by a committee consisting of John B. Hittell, Chief Street Engineer, Board of Local Improvements, Chicago, Illinois, chairman; Col. R. Keith Compton, Director of Public Works, Richmond, Virginia; Georgia C. Warren, Chairman of the Board, Warren Bros. Co., Boston, Massachusetts; B. S. Russell, Jr., Cuyahoga Asphalt and Paving Co., Cleveland, Ohio; Hugh W. Skidmore, President, Chicago Paving Laboratory, and C. C. Lakin, Manager, Asphalt and Fuel Oil Department, Standard Oil Company of Indiana, both of Chicago, Illinois, and J. S. Helm, General Manager of Asphalt Sales, Standard Oil Co. of New Jersey, New York City.

In his address formally opening the conference C. G. Sheffield of New York, president of The Asphalt Association, reviewed the remarkable progress that had been made by the asphalt paving industry in recent years, pointed to the importance of the petroleum industry as a factor both in the development of automotive industry and the successful working out of America's stupendous highway program. The petroleum industry, he said, now furnishes 95 per cent of the country's asphalt supply, and the yardage of asphalt pavements laid annually on the streets and roads of America has increased from 55,000,000 square yards in 1919, to 133,500,000 square yards laid in 1925. Touching upon the question of conserving the investment in the old roads, President Sheffield declared that "it is nothing short of an economic crime to tear up these roads, representing, as they do, millions of dollars in value and having a compact security unattainable with reasonable cost by any substitute."

Col. J. Franklin Bell, engineer commissioner of the District of Columbia, in welcoming the convention to Washington, discussed the Capital City's sweeping program for civic improvements now under way and stressed the work that is being done in widening the streets, planting trees, establishing parks and providing better school facilities

and a more adequate water supply. Among other things Col. Bell declared that there are in Washington approximately 800,000 square yards of asphalt pavements that are more than thirty years old and are still giving good service.

At the first session on Tuesday morning an interesting and profitable paper was presented by G. H. Henderson, state highway engineer of Rhode Island, in which state many trunk line highways are paved with asphalt macadam and are in excellent condition after being subjected to ten to fifteen years' gruelling traffic. The subject of Mr. Henderson's paper was "Causes of Success and Failure of Bituminous Macadam Pavements." Discussion of the paper was led by S. E. Fitch, county superintendent of highways, Jamestown, New York. Mr. Fitch's discussion was one of the best ever presented at a paving conference. Another interesting paper was presented at this session by R. M. Smith, chief engineer of Ontario Province, Canada, on the subject, "Asphalt Macadam by the Mixing Method." In this paper Mr. Smith stressed two advantages which he said favored this type of paving, one of which was that during construction there is no interruption to traffic and the second was that the entire output of the rock crusher is used, thus materially reducing the cost. A practical paper on "Surface Treatment by the Hot Application Method" was presented by N. S. Anderson, maintenance engineer of the South Carolina State Highway Department, describing the experience of his state in surface treating its highways with asphaltic oils. The presentation of this paper was followed by a most valuable and interesting oral discussion in which several new points were introduced. After formally opening the session President Sheffield turned the gavel over to J. E. Pennybacker, general manager of the Asphalt Association, who presided throughout the morning.

Senator Moses was the principal speaker at the afternoon session on Tuesday, being introduced by J. H. Cranford, Washington contractor and former president of the American Road Builders' Association, who presided. At the conclusion of the Senator's address the meeting resolved itself into a forum for an open discussion of two subjects of especial interest to contractors, namely, "Should Paving Contractors Be Licensed?" and "Cost of Incompetent Inspection to Contractor and Owner." The feasibility of legislation for licensing contractors was questioned but numerous, valuable and practical suggestions pertaining to the rating of contractors and a reduction of the evil of irresponsible contract bidding were offered from both the contractors' and engineers' standpoint by George C. Warren, of Boston; B. S. Russell, Jr., of Cleveland; I. W. Patterson of Meriden, Conn., and H. C. McClure, city engineer of Flint, Michigan.

Gen. R. C. Marshall, Jr., chief of construction in the United States Army during the World War, addressed the forum extemporaneously and the conference adopted a resolution commending the efforts that are being made by the Associated General Contractors towards devising a plan that will eliminate those evils of irresponsible contracting which are so detrimental to experienced, reputable contractors and so prejudicial to the public interest. Following the contractors forum the gathering listened to an interesting talk on Mexican oil production by W. J. Archer, representing the Mexican Petroleum Corporation, and saw a splendid motion picture, portraying the development of the petroleum fields in Mexico and presenting a striking view of a "gusher" coming in.

At the session on Wednesday morning, Dr. Felix Kleeberg, chief chemist of the borough of Manhattan, City of New York, read a paper on "Construction of Granite Block Pavements with Asphalt Filler"; prepared by C. M. Pinckney, the chief engineer of the borough. W. E. Rosengarten, traffic engineer. The Asphalt Association, New York, presented the subject of "Asphalt Maintenance Without Recourse to Large Plants"; Linn White, chief engineer, South Park Commission, Chicago, Illinois, gave an illustrated talk on the development of South Park, and Jay Downer, chief engineer, Westchester County Park Commission, Bronxville, New York, gave an excellent extemporaneous address "Parks and Parkways of Westchester County." H. B. Smith, county engineer of Burlington County, New Jersey, dealt with the subject of "Adaptation of City Pavements to County Highways," and described the successful transformation of eighty-five miles of macadam into sheet asphalt pavements at remarkably low cost. Mr. Downer in his address described the steps that have been taken over a period of several years and the results obtained through the expenditure of some $30,000,000.00 for an extensive system of park and parkways in his county. Among other things he described the construction of the beautiful Bronx River Parkway which connects New York City through the Bear Mountain Parkway with the famous Storm King Highway in "The Highlands of the Hudson," which is conceded to be the impressive scenic highway east of the Rocky Mountains. Mr. White told of the stupendous work that has been accomplished in the reclamation of 1200 acres of lake bottom in the South Park section of Chicago. Lake Michigan at this point has been filled in and many miles of asphalt paved parkways had been constructed on the fill. Col. R. Keith Compton, director of public works, Richmond, Virginia, presided throughout the session.

The session on Wednesday afternoon was held in the auditorium of the building occupied by the National Academy of Sciences and the National Research Council, was under the auspices of the Association of Asphalt Paving Technologists, and was devoted entirely to research discussions.

Francis P. Smith, an eminent consulting engineer of New York City, presided. The result of recent researches on asphalt paving mixtures constituted the text of most of the papers presented, and the subject of modification in cross-sectional design of asphalt pavement was also covered. The meeting was opened by an address from Dean A. N. Johnson, chairman of the Advisory Committee on Highway Research of the National Research Council, who welcomed the attending engineers, chemists and contractors and explained to them the organization and foundation of the engineering division of the National Research Council. W. J. Emmons, highway research specialist, U. S. Bureau of Public Roads, described apparatus devised in the bureau's laboratory for studying the resistance to displacement of asphaltic concrete mixtures, also for the determination of voids in mineral aggregates used in paving mixtures. Mr. Emmons was followed by Gene Abson, director of the Chicago Paving Laboratory, who discussed the voidage theory of asphalt paving mixture design in practice with special reference to shear strength methods attested and developed the importance of the reduction of voids in paving mixtures in order to obtain a more durable result in practice.

A paper upon the "Correlation of Stability Tests with the Behavior of Pavements under Traffic" was presented by Prevost Hubbard, chemical engineer, and F. C. Field, chemist, of The Asphalt Association. The stability test developed in the laboratory of The Asphalt Association measures the resistance of paving mixtures to the formation of ways and ruts under traffic, and much valuable data was presented establishing test values in connection with the behavior of asphalt pavements in the Borough of Manhattan, New York City, under the severe traffic conditions there encountered. "The Influence of Shape of Sand Grain on the Stability of Asphalt Paving Mixtures" was covered very thoroughly by Victor Nicholson, engineering chemist, Department of Public Works, Chicago, Illinois, who brought out the important point that while sharp or angular sand produced the greatest stability in low filler mixtures, rounded sand could be used with equal satisfaction if the mixtures were properly proportioned and sufficient mineral filler added. Henry L. Howe, Jr., director, Municipal Testing Laboratory, Rochester, N. Y., described a gasoline deterioration test for asphalt paving mixtures which had been developed in his laboratory, for the purpose of ascertaining whether or not a paving mixture was resistant to disintegration from automobile oil and gas drippings and water and frost action. A. T. Goldbeck, director of engineering, National Crushed Stone Association, discussed the theory of "Cross Sectional Design of Asphalt Pavements" and offered a number of valuable suggestions relative to a modification of present practice intended to increase the low carrying capacity of such pavements in an economic manner. These papers brought forth much valuable discussion from engineering, contracting and material interests. Among those participating in the discussions being C. R. Stokes of the National Lime Association; Frank B. Bosch, of the Central Construction Corporation; A. R. Ebberts, testing engineer, Allegheny, Pennsylvania, Highway Department; A. W. Dow, consulting engineer, New York City; Hugh W. Skidmore, consulting engineer, Chicago; Col. J. W. Howard, consulting engineer, Newark, New Jersey; H. J. Hughes, dean of engineering, Harvard University, Boston, Mass., and Chas. A. Mullen, director of Paving Department, the Milton Hersey Co., Ltd., Montreal, Canada.

The final session on the morning of Thursday, November 11th, was a joint one with the American Society for Municipal Improvements with T. C. Hatton, of Milwaukee, Wis., president of the A. S. M. I., and George W. Craig of Chicago, Middlewestern branch manager for The Asphalt Association, presiding jointly. Features of this session were papers on "Construction Details Essential to Effective Hot Mix Pavements" by Francis P. Smith, New York; on "Black Base and Its Place in Standard Specifications" by Hough W. Skidmore, president of the Chicago Paving Laboratory, and a paper by Col. R. Keith Compton of Richmond, Virginia, entitled "Economics of Salvaging Old Pavements." Discussion of Mr. Smith's paper was led by W. W. Horner, chief engineer, City of St. Louis, and A. F. MacAllum, Commissioner of Works, Ottawa, Ontario, Canada.

R. H. Simpson, city engineer of Columbus, Ohio, led the discussion of Col. Compton's paper. The paper presented by Mr. Skidmore was unusually instructive, as the author had made extensive personal investigations of black base pavements in all parts of the country—particularly in the vicinities of Richmond, Virginia; Pittsburgh, Pennsylvania; Patterson, Passaic and Trenton, New Jersey, and Chicago, Illinois, and on state highways in Michigan and other states. Mr. Skidmore presented very substantial proof of the long life, low maintainance, economy of construction and standardization of methods to be found in black base pavements, and he urged that black base be regularly included as a standard type of construction for both county and city traffic. The discussion by A. K. Vickory, city engineer of Denver, Colorado, and H. F. Harris, county engineer, Mercer County, New Jersey, emphasized the satisfactory results obtained with black base in Denver and in Mercer County. This type of construction, Mr. Vickory declared, is now the standard for Denver's great paving program, and in Trenton, New Jersey, Mr. Harris declared, experience has been very satisfactory with black base on highways carrying heavy industrial traffic. The paper by Mr. Smith outlined a number of im-

portant details which should not be overlooked in the construction of hot mix pavements, and his practical advice to road builders should result in substantial improvements in construction methods. In his paper outlining his experience with asphalt pavements, Col. Compton, besides discussing methods of salvaging old brick, granite block, concrete and other pavements with asphalt, stressed the economies to be effected thereby. The cost of a new base, he asserted, could frequently be saved.

Entertainment features for the convention included a bridge tea for the ninety-six ladies in attendance at the Washington Club with Mrs. A. E. Phillips, of Washington, as hostess; a supper-dance-divertissement in the Italian Garden of the Mayflower Hotel, with entertainment by professional entertainers from the "No, No, Nanette" Company and other organizations, and an all-day golf tournament on Friday, November 12th, at the Congressional Country Club. The golf tournament was in charge of a committee consisting of A. E. Phillips and E. M. Callis of Washington, and T. E. Collins of Elizabeth, New Jersey. Prizes were won by C. B. Filbert of the Cincinnati Quarries Co., Cincinnati, Ohio, and Troy Carmichael, city engineer of Helena, Montana.

On Thursday afternoon the 700 delegates attending the conference were transported to the Pimlico Racetrack near Baltimore to witness the running of the "Walden Handicap" and six other events as guests of the Standard Oil Company of New Jersey. Twenty-five buses were provided for the trip and a box luncheon was served en route. The guests occupied sections of the grand stand especially reserved for them, and as the weather was moderate everyone enjoyed the races to the fullest extent.

How to Reduce Credit Losses

Credit losses have been a source of grief to all engaged in business since the beginning. During recent years, however, such losses have become increasingly menacing to the welfare of commerce. This recent acceleration can be laid to many factors, but chiefly to the natural increase in population, wealth and mercantile pursuits.

Perhaps the most offensive source of credit losses is the large, and growing, number of bankruptcies. It requires more gray matter, of course, to put over a fraudulent bankruptcy than is usually employed by the average footpad or holdup man, but the enterprise is much safer and vastly more remunerative. Indeed, instances are known where ambitious crooks, anxious to get on in the world, have deliberately forsaken the evidently interesting work of bank robbery for the more lucrative, dignified and safer game of mercantile bankruptcy. So disturbing has become this tendency of late that the United States Business Service reports an annual "turnover" of 37 per cent in one single trade in New York City alone.

In consideration of this startling percentage it is gratifying to learn that the National Association of Credit Men is energetically back of a bill now before Congress designed to stiffen the bankruptcy laws and make fraud less easy. Not only is this law designed to effect the fraudulently inclined but put a stop to the creditor who unduly compromises with the bankrupt. As it is at the present time, creditors so well appreciate the almost unlimited chances afforded by our porous bankruptcy laws for the slick crook to slip through the fingers of justice that there is strong temptation to accept the 20 or 30 cents on the dollar and "let it go at that," rather than fight it out in the courts only to get a slim 10 per cent or thereabouts. Recognizing this attitude of mind, this is the very thing the crook plays for, after which he moves to parts unknown, assumes another name and possibly a different line of merchandise, and starts all over again.

Another factor that assists the fraudulent bankrupt is the ease with which anybody can get mercantile credit. Too many manufacturers and wholesalers, falsely viewing competition, allow their anxiety to sell goods eclipse their better judgment, with the result that people to whom the banks would not lend a dollar can secure goods with nothing more tangible as security than a typewritten letter or verbal promise. Nothing contributes so heavily to fraud as ease of credit extension, and unfortunately such credit is readily forthcoming from a large percent age of firms who too strenuously seek "sales." After all, a "sale" has been made only after the goods have been delivered and paid for.

As the United States Business Service puts it: "The matter of care in extending credit is especially important at the present time. When business is good and sales mounting, an over-liberal credit policy may work out pretty well, because the business and paying ability of the customer is increasing. But when business is receding, or there is a prospect of such recession ahead, there will be many failures of weak dealers with the best intentions. But when credit caution is most needed is the time when anxiety to get business is the keenest."

In addition to the eighty adjustment bureaus, in as many large cities, that are maintained by the National Association of Credit Men, there are countless good credit agencies from whom assistance in credit problems or information concerning applicants for credit may be obtained. In the interest of business conditions and personal protection, every business man should co-operate with the association, then enlist the aid of a reputable credit agency.

RECENT LIME DEVELOPMENTS

New Use for Lime

Hydrated lime as a filler in asphalt mixtures produces higher stability values than equivalent amounts of the more commonly used materials, investigations conducted over the last three years by Prevost Hubbard and F. C. Held, of the Asphalt Association, disclose. These investigations were instituted because a greater resistance to displacement is necessary in order that bituminous mixtures may successfully resist the stresses to which they are subjected by modern traffic.

The investigators went thoroughly into their work covering the entire field. They developed a highly satisfactory method of testing for stability asphalt briquettes, which might either be cored from pavements or prepared in the lavatory. Supplementary to their report they made the following statement:

"Recent investigations of methods of increasing and more closely controlling resistance to displacement of asphalt pavements under modern traffic have emphasized the very important stabilizing effect produced by mineral fillers as a constituent of paving mixtures.

"It has long been realized among paving engineers that fineness is a necessary characteristic of good fillers, but the effect of variations in fineness has never been thoroughly understood. Moreover, only a very limited number of types of finely divided substances have been used so far in paving practice.

"Among the little used products which are widely available in large quantities, hydrated lime gives promise of being particularly well adapted for use as a filler both on account of its extreme fineness and surface texture.

"It is believed that the research data secured relative to this material, coupled with practical results obtained where it has been used in actual construction, merits its favorable consideration by paving engineers in future work."

Summarized, the conclusions reached by the investigators based on their previous work and that presented in a bulletin by the National Lime Association entitled "The Value of Hydrated Lime as a Filler in Asphalt Paving Mixtures," are:

1. Hydrated lime is a more efficient stabilizing agent in asphalt paving mixtures than is the average limestone dust filler when used in the customary percentage of the total mix.

2. No difference in the stabilizing value of different limes can be attributed to differences in chemical composition, i.e., whether the lime is high calcium or high magnesium.

3. The maximum stabilizing and void reducing effect of hydrated lime in paving mixtures containing a well graded sand appear to be obtained by the use of approximately 15 per cent of lime.

4. In sheet asphalt paving mixtures with well graded sand it appears that about 13 per cent by weight of average limestone dust, and about 8 per cent of lime is equivalent to 15 per cent of limestone dust.

5. Hydrated lime appears to be better adapted for use with a relatively soft asphalt cement than is limestone dust, and when so used indications point to the production of mixtures of high stability at 140° F. which are less likely to crack in cold weather.

6. Hydrated lime is an especially desirable filler for use with uniformly fine sand and its superiority to limestone dust for such use may make available for sheet asphalt construction, fine sands which are at present eliminated by specifications.

Quick Setting Lime Products

Major E. Holmes and Gail J. Fink have secured a patent for quick setting lime products. This invention relates to the production of plastic materials which have quick initial setting properties and which are adapted to be used in the making of mortars, plasters, shaped articles such as blocks and the like.

This result is obtained by mixing with ordinary hydrated lime or lime putty varying percentages of such inorganic sulphates, preferably finely ground, as will react with lime after being mixed with water to form relatively insoluble compounds, the resulting product acquires quick initial setting properties. Various inorganic sulphates of the type referred to may be used but the best results have been secured with manganese sulphate and ferric and ferrous sulphates. Other sulphates which may be used are those of magnesium, nickel, cobalt, chromium, cadmium, and zinc. These sulphates are typical of those which do not produce an efflorescence and for this reason is not very desirable. As a specific example, illustrative of this invention, the following is given: A suitable plaster may be prepared by mixing 5 parts of dry manganese sulphate, such as $Mn\ So_4, 7H_2O$, with 95 parts of hydrated lime and adding one part of this mixture to 5 parts by weight of sand and the requisite amount of water. Such a plaster will set sufficiently in 9 hours to permit the application of a second coat. A similar plaster to which manganese sulphate has not been added will require 20 hours to set and to dry to the same degree.

The claim for this patent is a non-argillaceous plaster comprising substantially commercially pure hydrated lime, prepared by slacking with water and a soluble sulphate of a metal embraced with groups, given in patent, of the periodic table, reacting principally upon the hydrated lime to produce the quick setting properties.

A patent has also been obtained by Major E. Holmes and Gail J. Fink for a production of quick setting lime products by the addition of carbonates. The inventors claim that they have found that by mixing with hydrated lime or lime putty varying percentages of metallic carbonates, the lime acquires quick initial setting properties and thereby may be successfully used for plastering purposes and for the production of mortars, blocks, and the like. It appears that while the carbonates, in general, have accelerating properties, those which more readily hydrolyze have the most positive effect. For example, calcium, barium, and strontium carbonates which do not hydrolyze to any appreciable extent, are only slightly effective in reducing the time of set of plastic lime mixes such as lime mortar. However, magnesium, which readily hydrolyzes is very effective in producing an accelerated effect. Zinc, manganese and the ferrous carbonates are very active and materially reduce the time of set.

As a specific example, illustrative of this invention the following is given: a suitable plaster may be prepared by mixing 5 per cent of magnesium carbonate with a 1 to 3 lime mortar mix, that is 1 part of hydrated lime and 3 parts of sand, and adding the requisite amount of water. The percentage of addition agent added is calculated on the combined weight of the lime and addition agent. For example 5 per cent of magnesium carbonate means 5 parts of magnesium carbonate and 95 parts of lime. Such a plaster will set sufficiently in 6 hours and 30 minutes to permit the application of a second coat.

The materials forming the plaster mix are mixed in a dry state and there is no reaction between mix constituents until after water is added. Proceeding in this manner the accelerating agent, lime and other ingredients may be mixed at the place of manufacture and thereby a prepared dry plaster mix sent to the trade which requires only the addition of water to be immediately available for use.

This process claims a cementitious material having quick initial setting properties comprising hydrated lime and a metal carbonate which readily hydrolyzes.

A patent has also been secured by Frank C. Mathers and Russel L. Hardy for a process to make a production by carbonation and the addition of sulphates of plastic materials having an initial quick set. By the use of this method the inventors have found that quick initial setting properties nay be imparted to plastic materials such as hydrated lime and thereby the latter may be successfully used for plastering purposes and for the production of mortars, blocks and the like. They have found that when hydrated lime or lime putty that has been exposed to the proper proportion of carbon dioxide is mixed with a compound having a sulphate radical to form a plastic mass, the latter acquires quick initial setting properties. Either organic or inorganic sulphate compounds may be used.

Among the organic sulphates, aniline sulphate and dimethyl sulphates have given excellent results. However, in the preferred embodiment of this invention, the use of the metal sulphates is contemplated. The carbonation of the hydrated lime may be carried out as follows: The hydrated lime is placed in a cylindrical vessel provided with baffle plates and containing an opening adapted to receive a tube leading from a source of carbon dioxide. The carbon dioxide may be introduced with or without the application of external heat.

This process claim is for a plastic material having quick initial setting properties consisting of the reaction products of carbonated hydrated lime and a soluble compound having a sulphate radical.

John W. Stockett, Jr., has secured a patent for an invention which relates to the production of quick setting and quick hardening cementitious lime products of adequate strength and composed entirely of lime ingredients and the process of preparing the same. The main object of the invention is to provide a set and hardened composition prepared from substantially completely hydrated lime or a putty which is the hydrated lime mixed with water, and quicklime, which attains its set, and hardness, and strength quickly on transition from the plastic state without the use of accelerating agent other than that present in the hydrated lime and quicklime mixture.

Auxiliary to the main object, is the provision of a process of preparing the set and hardened composition. In order to prepare this quick setting product, quicklime is ground to a fine powder, preferably of such a fineness that all the particles will pass through a standard 50 mesh sieve and mixed with commercial hydrated lime in such proportions as to form when mixed a quick setting mixture, capable of expanding when it sets and hardens.

Examples of suitable plastering mixes are as follows: Scratch coat, 35 parts of finely powdered quicklime intimately mixed with 65 parts of hydrated lime, plus the desired amount of sand, filler such as hair and water. Brown Coat, 30 parts of finely powdered quicklime intimately mixed with 70 parts of hydrated lime plus the desired amount of sand and water. Finish coat, 20 parts of finely powdered quicklime intimately mixed with 80 parts of hydrated lime, plus the desired amount of water. A quick setting mixture suitable for building blocks, tiles and the like is 40 parts of finely powdered quicklime intimately mixed with 60 parts of hydrated lime plus the desired amount of water and such inert ingredients as wood fibre, saw dust, talc, limestone, asbestos and silica.

The claim for this invention is, a moldable composition comprising a mixture of substantially completely hydrated lime, water and finely ground

quicklime in such propositions as to induce the mixture to set and harden quickly on transition from the plastic state without the use of any accelerating agent other than that present in the mixture, said mixture being characterized by the properties of expanding on setting, failure to disintegrate on standing and the rapid development of a substantial tensile strength.

New England Lime and Cement Latest in Lime Plants

On Friday, November 19, the first lime kiln was fired at the new plant of the New England Portland Cement & Lime Company at Thomaston, Maine, starting in operation the most modern, low-manufacturing cost, lime plant in the United States. State officials, representatives from the City of Rockland, Town of Thomaston, representatives of the Lawrence Portland Cement Company, and building supply dealers from various parts of New England attended the opening and inspected the plant.

Alfred S. Black, President of the Company, made the important announcement that the Lawrence Portland Cement Company had signed a contract for the purchase of the plant and properties of the New England Portland Cement & Lime Co., and on passing of final papers were to construct a modern, portland cement plant, adjacent to the lime plant. The Lawrence Portland Cement company is one of the oldest cement companies and manufactures Dragon Portland Cement. The cement plant at Thomaston will be the only portland cement plant in the New England States.

The completed plant will include a modern cement plant of 3,000 barrels daily capacity, together with a lime unit of four Schaffer semi-automatic shaft kilns with a capacity of 500,000 barrels of burned lump lime per year. The first two of these kilns are completed and in operation.

The mineral deposit from which both lime and cement will be made consists of some 500,000,000 cubic feet of limestone suitable for the manufacture of Portland Cement and available for open quarry methods of recovery, together with some 650,000,000 cubic feet of stone underground, particularly adapted to recovery by mining methods. All of this stone has been proven both as to quantity and character by diamond drill cores and laboratory analyses.

This company's properties are directly on the seaboard and being approximately 1,000 acres in extent, cover all the known or probable limestone area in the formation that has not been operated at some former time. There are unlimited quantities of marine clay on or directly adjacent to the rock deposit. The company owns more than twenty acres on the Rockland waterfront, making it possible to ship by rail and water. The Maine Central Railroad runs through the property.

The kilns are of the Schaffer semi-automatic shaft type with an outside diameter of 17 feet three inches, and a height from firing floor to the top of the charging chamber of 53 feet. The supply of fuel to the kilns is handled in a manner that in some of its features is new to the lime industry. Crushed coal is dumped from hopper bottom cars through a track hopper and is crushed in the usual way, then conveyed by an incline scraper to a conical pile holding 2,500 tons stored in the open, adjacent to the quarry and kilns.

A standard type of reclaiming machinery in the form of a belt conveyor operating through a tunnel extending under the coal pile carries the coal into a chute which discharges above the quarry floor about 45 feet below the general plant yard level. This chute empties into a hopper from which the ordinary quarry cars are loaded with coal and moved over the quarry tracks and up the incline to the top of the kilns in a manner exactly similar to and on the same transportation system as stone used to charge the kilns.

Between number 1 and number 2 kiln a steel bunker extending from the top of the kilns down to a height of about 15 feet above the firing floor is constructed, using the steel kiln sides as two sides of the bunker and with flat plates extending from the center line of one kiln to the center line of the adjacent kiln, tangent to the kiln shells, then forming between the kilns a coal bunker with a capacity of 75 tons.

The lime when discharged from the coolers will be sorted by hand, as this is believed to be the only positive way of assuring proper selection. The most modern methods of barrel handling will be used and a Pulverizing department of the latest type will form a part of the plant.

The Officers of the Company are—Alfred S. Black, President; William R. Phillips, Vice-President and General Manager; Walter E. Bowe, Treasurer; Herman A. Mintz, Secretary.

1926 Automobile Production Ahead

Present figures, which cover the first ten months of 1926, indicate that the production of passenger automobiles in the United States would exceed the 4,000,000 mark by December 31, and that motor truck production would be in excess of 515,000. This is an increase over 1925 production of 10 per cent in passenger cars and 8 per cent in motor trucks.

For Canada, the 1926 automobile production has been estimated at 188,000 and while this is a figure small in comparison with the total produced in the United States, it none-the-less represents a 35 per cent increase over the 1925 production.

WISCONSIN MINERAL AGGREGATE ASSOCIATION HOLD EIGHTH ANNUAL MEETING

THE Wisconsin Mineral Aggregate Association held their eighth annual meeting on Thursday, December 16, 1926, in Milwaukee. Three sessions were held. The morning session was given over to an executive meeting and a closed meeting of members only. The afternoon session was given over to a program of speakers. This program was as follows:

"Installation and Care of Belt Conveyors," by William Phillips, Manager, Belt Conveyor Department of H. W. Caldwell & Sons Co., Chicago.

"Plant Lubrication" (illustrated), by A. W. Friend, Lubricating Engineer, Standard Oil Co., Milwaukee Division.

"Wisconsin's Concrete Highway Program for 1927," by John T. Donaghey, State Highway Engineer.

Motion pictures showing production operations of quarry of Michigan Limestone and Chemical Co., Rogers City, Michigan, accompanied by Fred Bradley, representative. (These films were shown through the courtesy of Messrs. Carl D. Bradley, president of the company, and Edward E. Gillen of Milwaukee.)

The annual dinner was held at the Elks Club. There was an excellent dinner, dancing and entertainment.

The following report of G. F. Daggert, executive secretary of the association, summarizes the association work:

"The year just closing has been a better year for our industry than was 1925. The building and highway programs have both been larger, calling for additional materials. In general, all companies have experienced a good year, but, of course, there are a few exceptions, due to local conditions in some parts of the state.

"The study of production and markets has been a most interesting one. In the plants of five companies this past season, production has not only been increased but the cost has been decreased by a short time study of some special condition that was encountered. Your secretary's services are available on call at any time of the day and it is his request that he be bothered with your individual problems and troubles. Oftentimes, through a few minutes' discussion, these problems can be solved by similar experiences had in other plants with which your secretary is conversant. This association stands for SERVICE and if it did not give value received in the form of service to its members and the consumers of our production, then there would be no excuse for its presence.

"The plant inspection and testing service carried on this year for the member companies of the association has been of untold value in many ways. This Wisconsin Highway Commission realizes that the high standard of the association with regard to production is not only being maintained but that it is carefully guarded from month to month. Then, too, several of the city engineers in Wisconsin have come to realize that, when material is supplied to one of their jobs by a member of this association, they need have no worry as to the quality. As time goes on, this testing and inspection service will be enlarged to meet the needs of the industry. It is the plan of your secretary, if time will permit, to make monthly inspections and analyses of material during the coming year, for, as you know, material varies in quality and gradation as it is produced from different parts of the deposit. Your secretary feels that more attention should be given to determining just what the quality of material produced by the various member companies is and also in determining, if possible, the logical work for said material.

"It is with pleasure that we report four new members in the association this year, namely, the Madison Washed Sand & Gravel Co., the Peters Sand & Gravel Co., the Waupaca Sand & Gravel Co., and the Wissota Sand & Gravel Co. The prospect for new members during the coming year is very good.

"At a recent meeting of the executive board, it was the consensus of opinion to spend more money in furthering the personal contact program that was rigidly adhered to during the year just closing, in visiting the pits and quarries and in association with the consumers of concrete aggregates. This personal contact was instrumental in obtaining two of the new members, because these two companies were sold on our service. There is a large field for association work and it is only by personal contact between representatives of the producers and the consumers that the field can be extended. Your secretary being new in the work this year, was more or less handicapped, but looks forward with a great deal of pleasure toward next season's work, as he is more thoroughly conversant not only with your production problems but with the consumers' problems and, with that knowledge, can carry on a greater service to all concerned.

"Another activity of your administrative office has been the study and correlation of various city specifications, with the idea of standardizing these so as to reduce the production problems. This study is still in progress.

"The car supply on the railroads was normal until about the early part of October, at which time conditions brought about a serious shortage of gondola

equipment for a few days. This shortage was felt in the Janesville, Waukesha and Milwaukee districts perhaps more than in some of the other districts, due partly to the fact that on October 1, just at the time when cars were needed for the late fall coal movement, summer coal loading on the Milwaukee docks was 2,500 cars short of normal. Reasonably good service was secured for our industry, however, through high officials of the railroads involved.

"The concrete highway program outlook for 1927 is considerably better than it has been in the last few years. The estimate now stands at better than 300 miles and details of this will, undoubtedly be given to you by Mr. Donaghey, our State Highway Engineer, in his talk this afternoon.

"The annual meeting as it appears in its three sessions today is somewhat of a departure from past procedure and is being tried out in an effort to give to the actual production men of the member and non-member companies, information that will assist them in the performance of their duties. After the meeting has closed this evening, your secretary will appreciate comments, either constructive or otherwise, with special reference to suggestions for next year's annual meeting. There is no reason why the annual meeting can not be made an educational event for superintendents and foremen, redounding to the benefit of all concerned, in the solution of specific production problems. The mere fact that these production men are mingling here today with one another is of great benefit, for the reason that as they are visiting, they will interchange experiences and ideas; and this is always helpful to an industry."

The following officers and members of the executive board were chosen for the coming year:

President—Geo. G. Brew of the Waukesha Washed Sand & Gravel Co.

Vice-president—M. W. Deutsche of the North Shore Material Co.

Secretary-treasurer—Edw. E. Gillen of the Waukesha Lime & Stone Co.

R. C. Brown, Sr., of The Western Lime & Cement Co.

C. R. Nutt of the Moraine Gravel Co.

L. L. Laun of the Elkhart Sand & Gravel Co., Inc.

G. D. Francey of the G. D. Francey Stone & Supply Co.

PLANT LUBRICATION

By A. W. Friend

THE Subject of Lubrication is intimately connected with the mechanical and operating condition of Engines and Machinery and, as a result, I will endeavor to present, for each type and piece of equipment used in the average Aggregate Plant, the technical background without which, it is futile to attempt to focus the lubricating problems as seen by the Engineer or the Chemist, and without which, it is impossible to determine the character of the oils required to give the best service.

I am well aware of the magnitude of such a task and the many shortcomings of the present work, but I venture to hope that the way I have dwelt with these problems and endeavored to convey my experience, may prove of some value in assisting you, gentlemen, in operating your equipment in a more efficient and economical manner and, by so doing, keep your maintenance cost within the bond of reason, and the consumption of electrical energy used in the operation of your equipment, at the minimum.

Inasmuch as my time is limited, it will be necessary for me to cover each subject pertaining to the Lubrication of Gravel and Quarry Plants, in as brief a manner as possible, touching upon only those things which I feel and believe will be of the greatest value to you. So my first subject will be—

(Paper delivered at the Eighth Annual Meeting of the Wisconsin Mineral Aggregate Association, Milwaukee, December 16, 1926.)

What Is Friction?

Friction is defined as the resistance caused by the motion of a body when in contact with another body which does not partake of its motion.

In the case of machinery in motion, the surfaces moving in contact have a tendency to adhere to each other. The minute projections, which exist on all surfaces to a greater or less extent, have a tendency to cling to each other and, in order to operate machinery without undue friction, the surfaces must be kept apart—something must be used that will flow or spread out over those surfaces and cover up these projections and prevent the surfaces from coming in direct contact, for which purpose, lubricants of various grades are used.

When one realizes that, were it not for this thin film of oil between the surfaces of the journals and their bearings, and the constant supply of oil to maintain this film, the largest locomotives could not start a heavy train or keep it in motion, the most powerful marine engine could not drive a ship a mile without heating up the bearings, one readily understands that a knowledge of Lubrication and Friction and of the Laws relating to Friction, is very important.

Some years ago, a survey was made by Professor Benjamin of the Case School of Applied Science, Cleveland, Ohio, to determine the actual amount of power used in productive effort, as well as the amount of power used in overcoming friction in the

various industrial plants in the state of Ohio. After this survey was completed,, he found that losses, due to friction, averaged 44.8% of the total horsepower developed. This figure was arrived at by dividing the total number of plants into the total friction losses. The smallest loss was found to be 14.5% of the total power developed, while the largest was 80.7 per cent of the total power developed.

Now, if these figures are true, and I believe they are, we can perhaps get some idea of the possible savings in dollars and cents in the average Gravel and Quarry Plant of today, operated by steam or electrical power. Let us assume, for instance, that we were able to reduce our Friction Losses just one horsepower per hour or, in electrical terms, 746 watts per hour, our savings, based on 10 houre of plant operation, would be as follows:

$$\frac{746 \times 10}{1000} = 7.46 \text{ K. W.}$$

7.46 K. W. $\times$ 3c per K. W. = 22.38c per day.
22.38c per day $\times$ 6 days per week = $1.34.
$1.34 $\times$ 52 weeks = $69.68 in round numbers per year of 52 weeks of operation.

I do not know that I could use a more conservative figure than this but I do know that whatever effort is put into the reduction of friction losses, is sure to reduce the cost of each ton or yard of material handled and I also believe that whatever affects the cost of producing a ton or a yard of material is of vital importance to all operators of gravel and quarry plants.

Lubrication of Electric Motors

Now, let us see just how lubrication affects the operation of equipment, and just what part lubrication plays in the economical and efficient operation of any plant. Let us single out one piece of equipment at a time and see what lubrication has to do with its operation. Let us take for our first illustration, an Electric Motor, equipped with oil ring type bearings.

We know this motor requires lubrication in order to function properly and we also know that, inasmuch as the clearance space is small between Journal and Bearing, it is necessary to use an oil that is low in viscosity or, in other words, a light bodied oil. The reason we select a light bodied oil is because our clearance spaces are small and it is necessary for this reason to select an oil with a high penetrating and heat dissipating value. Our selection, of course, must be governed by the size of the motor.

Where motors are exposed to high temperature conditions, heavy duty and slow speed, an oil of a medium heavy body is required, while in the small size motors from 1 to 50 horsepower, an oil of 150 seconds viscosity will be found to give the best results.

But, regardless of the oil we use, the bearings must be kept free from grit and abrasive material in order to function properly and this can be accomplished only by flushing the bearings as often as necessary and then charging them with fresh oil.

Do not run your belts, connected with motor to counter or line shaft, any tighter than is necessary to pull the load as any degree of tightness other than is necessary to pull the load, only tends to increase the bearing pressures per square inch and, as a result, the friction losses. Use a chain drive if your pulley centers are close together and you will pay for your chain drives in the savings effected by a reduction in bearing pressures and the savings in electrical energy consumed.

Lubrication of Screw Bearings

In the lubrication of screw bearings, grease of one variety or another is employed and, while grease is an excellent lubricant for this type of bearing, which is usually of the Plain Babbitted variety, the human element determines the success of this class of lubrication.

I have, in my many visits to various aggregate plants, marked grease cups with a piece of chalk to see how often they were turned down and I was very much surprised to find that, in some instances, it was fully three days before they were even looked at and, in some instances, not at all. Grease will always form a fillet around the shaft just outside of the bearing, keeping grit and abrasive material from entering the bearing and causing excessive wear, but, unless grease cups are screwed down as they should be and as often as necessary, the human element makes grease lubrication a very unreliable medium.

I would recommend that, wherever gravity grease cups can be employed, they be used and also a grease adapted to the use of this type of a grease cup. This will enable you to get constant lubrication as long as there is any grease in the cup, and you are not depending upon the human element for their operation.

Lubrication of Gearing

In the lubrication of open gearing, a very viscous material is employed, or it should be one that is viscous enough to withstand heavy pressures without squeezing out, and retain a good heavy film of gear compound over a reasonable period of time.

In this class of lubrication, we are interested in only one thing and that is the wear that takes place on the teeth. In order to keep this wear down to the minimum, we must employ a gear lubricant manufactured especially for this class of lubrication. Those lubricants are usually so viscous or heavy that they must be applied hot with a brush after the gearing has been thoroughly cleaned of all grit, dirt and oil.

On inclosed gearing, such as worm gears, bull gears, etc., which are completely inclosed, a lighter bodied gear oil is usually employed. The reason

for this is that the gears run in a bath, so to spaek and, as the oil housings surrounding these gears are oil tight or nearly so, all gear oil thrown off is retained in the gear housing where it again finds its level in the bottom of the housing, to be used over again.

If those housings are oil tight, so that no waste occurs, it is necessary only to replenish the oil supply at long intervals. I would suggest that the oil level in old inclosed gear cases be kept at a point where there is not much more than ½ to 1 inch tooth submergence in the lubricant for, if the oil level is carried above this point, you are not improving the lubrication of the gears but you are throwing an additional load on your motor, due to the high fluid friction of this class of lubricants.

Chains and Wire Rope

In the lubrication of chain and wire rope, various compounds and preservatives are used. In the lubrication of wire rope, a very viscous lubricant is used which is necessary to apply hot in order to get the best results. The object of heating a Wire rope dressing is to increase its penetrating value so that it will soak into the small clearance spaces around each strand and, by so doing, keep out the moisture and grit that works its way into these small clearance spaces, causing excess wear and deterioration. The rusting and wasting away of wire cables can be prevented by using a suitable cable coating and the life and usefulness of them increased considerably. The same holds true of the chain as the chain is subject to a great amount of wear which can be greatly reduced by the use of a proper chain lubricant. These lubricants are also very viscous and are usually applied hot, in order to get the best results. After the chain has been soaked or coated with this hot grease, it will work without further lubrication for a long period, whereas, when oil is used, it is often necessary to lubricate them two or three times per week.

Conveyor Belt Idlers

In the lubrication of Idler Pulleys, a grease is almost always employed and I personally have no fault to find with grease if it is of the proper consistency and the grease cups in which it is used are screwed down as often as conditions require, but how often do we find this condition.

I have seen idler pulleys on conveyor belts that could hardly be turned by hand and when one takes into consideration the detrimental effect a condition like this has on the surfaces of the Conveyor Belt, rubbing against these frozen idlers, we have not only the friction losses to contend with but another source of maintenance cost to take into consideration.

Idler pulleys, like any other piece of equipment, must be lubricated if it is expected to render the service that it was intended to give and, when they are not lubricated as they should be, you are paying for electrical energy that is non-productive. I am referring to the plain bearing type of Idler Pulleys that are most commonly used.

Lubrication never did and never will eliminate friction entirely, but it has played a very important part in reducing it to the minimum, therefore, it is of the utmost importance to not only select the most correct lubricants for each condition and the devices for the proper application of these lubricants, but also the proper bearings and bearing metals that will give you the lowest co-efficience of friction.

The greatest reduction of friction loss in heavy machinery has been attained by the use of roller bearings and, by their use, heavy shafting has been run under greater pressures than would otherwise have been practical. There are two general types of roller bearings which do not differ much in their application.

Among the advantages of the Roller Bearings over the plain bearings are the reduction of friction losses from 25 to 35 per cent and of the friction of line shafting from 50 to 60 per cent. The other advantages will be found in decreased oil consumption, freedom from hot bearings and a reduction of cost and maintenance of belting.

Some years ago, I had the opportunity of witnessing some tests being conducted on two machines used in the manufacture of paper and known as super-calendering machines. These machines required 40 horsepower to pull them or, rather, operate them, with plain bearings. After being equipped with roller bearings, only 20 horsepower was required on the same production schedule. A saving of 100 per cent in the horsepower consumed or, putting it in dollars and cents, $700.00 was the saving effected based on the cost of $35.00 per horsepower per year.

I believe there are a great many conditions in the average Gravel and Quarry Plant where the use of roller bearings would prove a profitable investment and it is for this reason that I have touched upon the subject of Roller Bearings and their application.

Second part of this article will appear in January 5, 1927 issue.

The manufacturer who cuts his price to meet or beat competition injures far more than merely himself and his business. In addition to cutting his own throat he effects every other manufacturer making a similar product, for they too, in the face of such competition must of necessity either take something out of their quality or out of the manufacturing costs if they are to maintain their volume of business and their average profits. The only sound and ethical way of cutting the price of any product is to reduce the cost of manufacture and leave the margin of profit untouched.

DISTRIBUTION OF CEMENT

Portland cement shipped from mills into States, in September and October, 1925 and 1926, in barrels*

Shipped to	September		October	
	1925	1926	1925	1926
Alabama	192,882	153,636	158,310	169,086
Alaska	455	668	528	132
Arizona	34,380	42,709	33,577	44,360
Arkansas	54,377	75,962	52,339	70,785
California	1,120,092	1,204,615	1,125,094	1,276,210
Colorado	122,128	137,054	103,024	113,951
Connecticut	232,265	255,785	230,906	242,167
Delaware	63,024	46,600	63,752	44,898
District of Columbia	84,260	94,183	94,295	90,347
Florida	522,465	315,214	535,817	343,404
Georgia	134,340	160,377	134,198	148,699
Hawaii	3,511	17,179	8,086	16,887
Idaho	24,959	34,221	21,228	33,444
Illinois	1,658,700	1,458,052	1,257,184	1,918,899
Indiana	625,962	646,062	476,635	719,882
Iowa	368,763	350,251	259,971	501,683
Kansas	205,607	226,069	215,258	244,497
Kentucky	196,628	246,310	139,790	192,177
Louisiana	80,907	108,642	77,948	123,139
Maine	40,051	90,934	40,243	47,136
Maryland	260,019	249,489	196,739	270,241
Massachusetts	326,615	358,853	349,702	305,190
Michigan	1,195,566	1,372,831	992,423	1,159,596
Minnesota	455,011	407,570	376,854	384,739
Mississippi	56,979	79,924	41,777	68,149
Missouri	597,568	457,632	505,730	498,449
Montana	24,598	30,597	19,205	27,916
Nebraska	206,703	169,159	193,568	173,552
Nevada	10,598	10,291	10,048	7,955
New Hampshire	48,675	56,092	52,975	44,983
New Jersey	809,251	866,717	847,301	856,615
New Mexico	12,945	17,738	15,687	22,127
New York	2,006,604	2,490,511	1,880,822	2,107,119
North Carolina	354,835	412,719	328,705	382,736
North Dakota	33,458	46,528	28,020	30,647
Ohio	1,118,150	1,137,722	870,645	989,005
Oklahoma	195,542	219,399	212,696	188,144
Oregon	157,333	150,679	155,066	126,946
Pennsylvania	1,937,173	1,620,018	1,490,931	1,415,233
Porto Rico	346	0	0	0
Rhode Island	71,846	56,575	84,229	72,653
South Carolina	82,742	55,967	69,548	61,636
South Dakota	56,838	47,794	41,532	48,761
Tennessee	171,080	239,051	118,768	203,406
Texas	328,962	430,727	290,946	441,775
Utah	44,564	56,948	40,238	64,504
Vermont	28,794	50,697	31,509	34,591
Virginia	184,071	191,720	156,782	151,319
Washington	258,182	202,117	254,164	191,453
West Virginia	201,698	188,894	193,757	143,112
Wisconsin	513,479	594,999	285,712	582,919
Wyoming	20,461	23,893	16,522	15,475
Unspecified	74,427	73,748	36,326	13,132
	17,610,869	18,032,122	15,217,110	17,425,861
Foreign Countries	100,131	54,878	91,890	60,139
Total shipped from cement plants	17,711,000	18,087,000	15,309,000	17,486,000

*Includes estimated distribution of shipments from three plants in September and October, 1925; and from five plants in September and October, 1926.

Production, shipments, and stocks of finished Portland cement, by districts, in November, 1925 and 1926, and stocks in October, 1926, in barrels

Commercial District	November Production		November Shipments		Stocks at end of November		Stocks at end of October
	1925	1926	1925	1926	1925	1926	1926*
Eastern Pa., N. J. and Md.	3,457,000	3,617,000	2,909,000	3,356,000	1,353,000	2,697,000	2,437,000
New York	872,000	820,000	609,000	609,000	670,000	896,000	685,000
Ohio, Western Pa. and W. Va.	1,241,000	1,157,000	852,000	1,067,000	1,904,000	2,151,000	2,062,000
Michigan	988,000	1,227,000	585,000	781,000	1,318,000	1,471,000	1,026,000
Wis., Ill., Ind., & Ky.	1,941,000	1,930,000	1,211,000	1,143,000	2,882,000	2,084,000	1,296,000
Va., Tenn., Ala., & Ga.	1,192,000	1,290,000	754,000	1,233,000	722,000	1,124,000	1,067,000
Eastern Mo., Ia., Min. & S. Dak.	1,220,000	1,310,000	769,000	602,000	2,422,000	2,317,000	1,609,000
West. Mo., Neb., Kan. & Okla.	859,000	821,000	818,000	739,000	1,559,000	1,538,000	1,455,000
Texas	399,000	402,000	356,000	427,000	426,000	381,000	406,000
Colo. Mont. and Utah	95,000	200,000	128,000	156,000	453,000	450,000	406,000
Calif.	1,099,000	1,154,000	1,029,000	972,000	529,000	662,000	480,000
Ore. & Wash.	293,000	265,000	167,000	205,000	296,000	466,000	405,000
	13,656,000	14,193,000	10,187,000	11,290,000	14,534,000	16,237,000	13,334,000

*Revised.

Domestic hydraulic cement shipped to Alaska, Hawaii, and Porto Rico, in October, 1926†

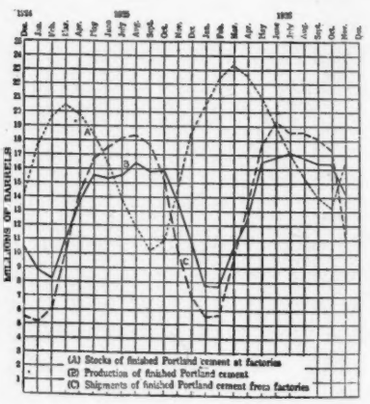
	Barrels	Value
Alaska	633	$ 1,935
Hawaii	17,014	38,377
Porto Rico	5,195	11,865
	22,842	$52,177

†Compiled from the records of the Bureau of Foreign and Domestic Commerce and Subject to revision.

NOVEMBER CEMENT STATISTICS

November production of Portland cement shows an increase of about 4 per cent and shipments an increase of nearly 11 per cent as compared with November a year ago, according to the Bureau of Mines, Department of Commerce. Portland cement stocks at the end of November, 1926, were almost 22 per cent higher than at the end of the preceding month, and were nearly 12 per cent greater than the stocks at the end of November, 1925.

These statistics, prepared by the Division of Mineral Resources and Statistics of the Bureau of Mines, are compiled from reports for November, 1926, received direct from all manufacturing plants except two, for which estimates were necessary on account of lack of returns.



Stauffer Reorganizes

Through a merger of sand and gravel deposits owned by Mr. J. H. Stauffer, head of the Stauffer Trucking Company and the Salt Lake Sand and Gravel Company, a reorganization has been effected and a new company incorporated consolidating all these properties. The new corporation will be called the Stauffer Sand and Gravel Company, with offices at 50 South 2nd West Street, Salt Lake City, Utah.

It will produce from all the pits operated by the Salt Lake Sand and Gravel Company, in addition to which it has acquired a very large deposit of excellent sand and gravel land adjoining its present Salt Lake pit, which, with the cooperation of the Stauffer Trucking Company and the installation of new equipment, assures prompt service, increased output, and a quality of material to suit any requirement, both local and carload.

Production, shipments, and stocks of finished Portland cement by months, in 1925 and 1926, in barrels

Month	Production		Shipments		Stocks at end of month	
	1925	1926	1925	1926	1925	1926
January	8,856,000	7,887,000	5,162,000	5,674,000	17,656,000	20,582,000
February	8,255,000	7,731,000	6,015,000	5,820,000	19,689,000	22,384,000
March	11,034,000	10,355,000	10,279,000	9,539,000	20,469,000	23,200,000
1st quarter	28,145,000	25,973,000	21,456,000	21,033,000	.....	.....
April	13,807,000	12,401,000	14,394,000	12,961,000	19,877,000	22,640,000
May	15,503,000	16,472,000	16,735,000	17,951,000	18,440,000	21,173,000
June	15,387,000	16,827,000	17,501,000	19,113,000	16,409,000	18,900,000
2nd quarter	44,697,000	45,700,000	48,630,000	50,025,000	.....	.....
July	15,641,000	17,096,000	18,131,000	18,786,000	13,896,000	17,210,000
August	16,419,000	16,936,000	18,383,000	18,536,000	11,952,000	15,718,000
September	15,939,000	16,571,000	17,711,000	18,087,000	10,247,000	14,195,000
3rd quarter	47,999,000	50,603,000	54,225,000	55,409,000	.....	.....
October	15,992,000	16,596,000	15,309,000	17,486,000	10,979,000	*13,334,000
November	13,656,000	14,193,000	10,187,000	11,290,000	14,534,000	16,237,000
December	10,713,000	.....	6,917,000	.....	18,515,000	.....
4th quarter	40,361,000	.....	32,413,000	.....	.....	.....
	161,202,000	.....	156,724,000	.....	.....	.....

*Revised.

EXPORTS AND IMPORTS*

Exports of hydraulic cement by countries, in October, 1926

Exported to	Barrels	Value
Canada	2,431	$ 12,374
Central America	14,136	37,033
Cuba	8,065	20,759
Other West Indies	6,565	15,178
Mexico	4,862	16,208
South America	29,449	101,110
Other Countries	3,881	23,212
	69,389	$225,874

Imports of hydraulic cement by countries, and by districts, in October, 1926

Imported from	District into which imported	Barrels	Value
Belgium	Los Angeles	54,	$ 114
	Maine and New Hampshire	11,998	51,610
	Massachusetts	82,552	90,499
	Mobile	57,048	100,066
	New Orleans	39,557	51,388
	Oregon	2,997	4,857
	Philadelphia	39,373	60,726
	Washington	3,003	4,185
	Total	236,582	$363,445
Canada	St. Lawrence	506	930
	Vermont	222	374
	Total	728	$ 1,304
Denmark and Faroe Islands	Porto Rico	6,780	11,208
France	New Orleans	655	1,890
	New York	739	2,368
	Total	1,394	4,258
Germany	New Orleans	2,859	2,285
Japan and Chosen	Hawaii	2,496	4,898
Netherlands	Maine and New Hampshire	9,085	18,720
United Kingdom	Massachusetts	500	787
	New York	2,979	5,510
	Total	3,479	$ 6,297
	Grand total	263,403	$412,415

Exports and imports of hydraulic cement, by months, in 1925 and 1926

Month	Exports				Imports			
	1925		1926		1925		1926	
	Barrels	Value	Barrels	Value	Barrels	Value	Barrels	Value
January	71,596	$ 207,547	72,939	$216,431	231,258	$ 364,196	360,580	$576,717
February	56,249	181,356	73,975	220,706	119,077	206,308	314,118	527,948
March	65,248	200,410	69,080	205,647	218,048	337,039	493,241	812,968
April	89,508	263,831	96,296	284,772	197,686	280,826	257,302	398,114
May	85,385	250,845	78,601	224,365	186,897	286,959	223,130	337,031
June	71,343	217,899	80,684	248,814	254,937	409,539	335,570	495,744
July	98,141	286,543	130,822	370,220	335,118	499,602	250,862	395,981
August	103,961	289,904	64,946	216,489	379,847	611,551	350,638	560,532
September	102,649	285,225	70,920	239,174	513,252	789,121	194,129	308,224
October	73,369	228,467	69,389	225,874	535,050	824,268	263,403	412,415
November	101,825	294,201	.....	.....	388,604	678,518	.....	.....
December	100,323	296,900	.....	.....	295,543	526,001	.....	.....
	1,019,597	$3,003,128	.....	.....	3,655,317	$5,813,928	.....	.....

*Compiled from the records of the Bureau of Foreign and Domestic Commerce and subject to revision.

New Air Filter

The American Blower Company announces a new air filter that is new in design and eliminates many difficulties heretofore found in air filters. By means of this new filter, which is of dry plate design with hair-like tentacles for the arresting and retention of dust and dirt, dust-laden air is divided into a series of small jets which strike the flat filament coated surface of the plates, dust and soot are projected against the filament, seized and retained. The air, changing its direction and rebounding from this surface flows through to the next plate and is carried through ten successive dust removal operations of this type. As dust builds up on these flat surfaces, each preceding layer acts as a retentive member, the dust itself being the principal dust arresting and retaining factor for the ensuing particles of dust and dirt. In this way, the use of adhesives is avoided and the maximum load of a cleaner or filter is multiplied many times.

The advantages of this type of air filter are that it is impossible to clog the filter, that it does not require oil or other adhesives which have to be changed from time to time, that it has a constant effect and constant efficiency and that dust builds upon dust and dust does not get in the line of air flow.

Link Belt Road Show Exhibit

The exhibit of Link-Belt Company at the Good Road Show in Chicago's Coliseum, will be in charge of a representative group of Link-Belters. Besides the Link-Belt grizzly leaders, and a model sand and gravel plant, each moving part of which is a miniature replica of Link-Belt equipment which will be kept running each day during the Show, the new type K-42 All-Purpose crawler crane will be shown.

This is a new super-duty machine of 1¼ cubic yards capacity, with oversize brakes, clutches, drums, and other working parts. This new K-42 machine is designed with the thought in mind that the various kinds of digging and speed of operation which should reasonably be expected of a machine of this capacity, subjects it to innumerable shocks and terrific strains.

Thus strength, ruggedness, oversize wearing parts. speed of operation and large capacity are the special features claimed for the new Crawler. It is asserted that this new machine, by virtue of its ruggedness, and its all-around strength, will be decidedly instrumental, in eliminating breakdowns and rapid wear of parts, with the consequent loss in time and money.

Interesting Aerial Tramway

An interesting aerial tramway was designed and manufactured, early in this year, by the Interstate Equipment Corporation, and installed at the plant of the Nephi Manufacturing Company at Nephi, Utah. This company is one of the oldest producers of gypsum in the Western districts. Nephi plaster has been a well known product in the building trades on the Pacific coast and mountain states for the last two decades. The plaster mill is located on the San Pete branch of the D. & R. G. railroad near Nephi, Utah. Gypsum from the old deposit within easy hauling of the mill was obtained by both mine and open quarry methods. In 1925 the company decided to open extensive deposits in a mountain range some two miles distant from the mill where a long series of tests showed up extensive deposits of a superior quality of gypsum.

The country between the new deposit and the mill is especially rough so that surface hauling was entirely out of the question. The mine mouth is at elevation 6,000 and the floor of the valley below at approximately elevation 4,900. An Interstate Automatic Aerial Tramway stretching in an air line from the mine mouth to the mill is approximately 9,500 feet in length, with a net drop between terminals of 570 feet. At the mine mouth a bin of approximately 600 tons capacity was installed in a cut on a steeply sloping hillside.

Sanford Day bottom dump mine cars are used and the mine tracks are built over the bin which runs longitudinally with the center line of the tramway so that the full storage capacity of the bin is readily available. The tramway terminal is installed under the bin and a movable automatic loader makes it possible to take material from any of six pockets through undercut gates. The tramway is of the standard terminal discharge type, the system in general being a series of continuously moving four-wheeled cars, propelled by an endless haul rope. Two sets of track cables support the cars, the upper cables carrying the loaded cars and the lower cables the returning empty cars.

At strategic points track cable supporting towers are installed, the towers being of several different designs to suit varying conditions. The tramway is divided into seven sections. At each section the track cables are anchored at one end and attached to counterweights at the other end, so that the cables are stressed to a constant tension at all times. Between these anchor or tension towers intermediate towers are placed to hold the track cables at a calculated deflection so that the entire line from terminal to terminal forms a smooth roadway for the passage of the tramway cars.

At the discharge terminal the tramway cars pass through a fixed rail section forming a letter "U" placed on its side. The cars are inverted as they pass through this section and their loads discharged onto a baffle plate. Below this baffle plate are three chutes controlled by a three-way gate so that material may be deposited into any of the three bins, each having a capacity of 200 tons.

The rock gypsum is taken from these bins direct to the primary crusher by gravity feed. At the present time the tramway has a capacity of approximately 40 tons of rock gypsum per hour and operates by gravity. A 50 h.p. Buda gasoline engine is installed at the upper end, however, for driving the line when there is not sufficient material coming from the mine to load each bucket to full capacity, as at such times power is required to keep the line moving.

The management plans installing electric motors at the tramway terminal to light the mine and furnish power for air compressors and other uses about the mine or tramway. The tramway was designed for an ultimate capacity of 80 tons per hour and to acquire this capacity it will only be necessary to add a number of tramway cars to those already in service.

Interesting Development in Dust Collecting

An interesting development in dust-collecting installations is reported by the Northern Blower Company, in connection with its Norblo dust-collecting equipment. Although at present the new method has been applied to cement plants only, it would seem probable that some modification of it could be used in many other industrial processes in which the recovered material can be utilized in subsequent operations.

In the case of cement plants, the daily output is largely governed by the capacity of the grinding machines, hammer-mills, dryers, etc., for reducing the materials to the required degree of fineness. The dust produced at each successive operation is removed by an exhaust hood connected to the dust-collecting system, but in the new method, instead of this dust being collected in hoppers, it is by-passed direct to the kilns; the air-suction being regulated so as to pick up at each hood all the material which is already fine enough to be fit for the kiln. In this way, the output from each machine is increased, and the cost per ton produced reduced. Dust from coal-crushing and drying apparatus and from screw conveyors may be handled in a similar manner.

Koehring Shovel with Power Dipper Trip

A power dipper trip has recently been brought out by the Koehring Company, Milwaukee, manufacturers of pavers, mixers, gasoline shovels, cranes and draglines, and has been made optional equipment on Koehring Heavy Duty Gasoline Shovels. It conforms to the Koehring principle of Finger-Tip control and is so constructed that one finger can move the lever which trips the dipper. The operator is able to trip it swiftly and without effort.

It is a well known fact that one man can coordinate these movements of a machine better than two men. The operator can trip his dipper at the exact instant it reaches the desired place without any delay from a second man. Through the day this means a definite gain in yardage—another advantage of the power dipper trip.

A slight tension on the line is a third improvement over the old method. There is no loose rope down in the pit when digging or over the truck when unloading. With power operation, only a short lever needs to be attached to the dipper stick for pulling the pin on the dipper. This construction permits the trip cable to follow a parallel line very close to the dipper sticks.

The power for the trip cable is obtained by building a small drum, with heavy brake lining on the outside, on the end of the rear drum shaft. A second steel drum, polished on the inside and placed over the first drum, turns when there is sufficient friction between the two. The operator merely controls this friction with a lever so as to apply power to the trip cable which is attached to the outside drum.

New Barber-Greene Office

The Barber-Greene Company has opened a new office in Kansas City, Missouri, at 2045 Main Street. Mr. E. H. Cooper, District Manager of the Barber-Greene Company will be in charge. The complete Barber-Greene line, including ditchers, loaders, portable conveyors and coal handling equipment will be handled through this new office.

Miscampbell Dust Collector

The vexing question of dust around lime plants and its disposition, has, this year, resulted in the manufacture of the new dust collector by H. Miscampbell, manufacturer of the Clyde Lime Hydrator. This apparatus has been in operation at the Cutler-Magner Company's plant at Duluth since early spring and has relieved that Company of its worries due to the spreading of dust on roofs and through windows of their neighboring industries, which at one time caused considerable trouble.

The Miscampbell Process for collecting the dust from lime hydration consists in passing the gases carrying the dust through a heavy fog created in a suitable apparatus, sufficient water being used to wash away the arrested dust and return it as putty and milk of lime to the water measuring tank over the hydrator. The apparatus not only effectually collects the dust passing off as the slaking takes place, but acts as a condenser, returning the greater part of the steam generated and thus adding to the washing effect as well as returning the water for use in the hydration process.

The Collector consists of a cylinder 5 feet in diameter and approximately 14 feet long, connected by tight joints with the source of the dust and steam. Through this cylinder, slightly above its center, is placed a hollow shaft properly supported by bearing and carrying outside the collector, a pulley for driving. This shaft is closed at the receiving, or hydrator, end of the cylinder, and at its other end, outside, is connected through a stuffing box, with a clean water supply. This water should be under a pressure of from 5 to 7 pounds per square inch. This pressure is maintained by setting a small water tank at a sufficient height above the collector and connecting it by piping, through a stationary stuffing box, to the hollow shaft. The proper water level is held by regulating the flow of water from well or city mains by means of an ordinary globe valve.

Set in the hollow shaft, at intervals approximately 1½ inches apart along its length, are a number of brass nozzles, each one set to produce a fine spray, when under proper pressure and stationary. The shaft is rotated at from 350 to 400 RPM and this rotation, with water turned on and nozzles open, produces in the collector a dense fog. A small fan, with blades adjusted to meet the conditions under which the hydrator is working, is also placed on the shaft. Absence of this fan and the slight draft up away from the hydrator, will plug the draft because of the cold area produced in the collector and as a result, the dust is likely to kick back out into the hydrator room. As the steam and dust is carried into the fog by the fan draft, aided by that from the slaking, the steam will be condensed so that a partial vacuum will be formed and the effect of passing the gases into large expansion chambers filled with moisture is produced. In addition, the condensed steam adds to the water already in this confined space and a real washing effect is had.

Each collector must be adjusted to fit the conditions at any plant, as that is a decidedly variable factor. Excess water used in the collector above that required for hydration, will run off through overflow arrangement in the water tank underneath. This overflow should not be returned directly to the water supply system, but should be taken to settling tanks, from which the overflow can then be returned for re-use if water cost is an appreciable item. The settling tanks can be emptied from time to time and lime putty reclaimed, though this will be a small amount.

In hydrating very pure high calcium lime, a large percentage of water is added to the ground lime. Oftentimes one-half of this large quantity of water will, in the space of two minutes, pass off from the hydrator as steam, carrying with it a large amount of dust. Such a lime might act so rapidly that, under certain atmospheric conditions, the rush of steam would, momentarily, overcome the condensing and washing effect in the collector, for a minute or even two minutes during the cycle of operation and carry some of the dust by with it. So, as a precautionary measure and to assure that this possible slight loss of dust is overcome, a baffle stack is placed with over twice the cross-section of the main collector, and this will completely collect any small quantity of dust that might possibly get by the washer.

This equipment is also applicable, with some further modifications in order to facilitate returning the wet slurry, to wet process cement plants.

New Mortar and Putty Plant

The rapidly growing demand for ready mixed mortar has brought out, among others, an entirely new idea in a mortar and putty making plant. This equipment is manufactured by H. Miscampbell, who also manufactures the Clyde lime hydrator.

Most installations call for expensive layouts and a lot of ground space. This new development may be installed within the space of an ordinary 25 foot city lot, with still room to spare for some storage. To be successful a mortar plant must meet the following requirements: It must be capable of producing a uniform product of the right composition, perfectly mixed. It must have a low operating cost; It must have a low first cost.

The same methods used with success in connection with the Clyde hydrator, are used in placing these new mortar plants. Thus, for each separate installation and the individual limes used, tests are made to determine the proper amounts of water to add, the rate at which it should be added and the length of time to be allowed each batch in the mixer before delivery to the soaking bins. In the same way, by tests, the proper proportions of sand and hair are determined so that the maximum production may be coupled with the right consistency and spreading qualities.

The equipment provides, first, for the fine crushing of the lump lime, in order that the moisture may quickly and thoroughly penetrate every particle. The crushed product is then elevated to a storage bin above the mixer. From the bin it is delivered to a standard weighing hopper, the same as used with the Clyde hydrator. Here, then, is the first step, a predetermined amount of lime is weighed and placed in the mixer. Next, the water found necessary is added, exactly, from a Clyde standard graduated tank.

The mixer is a closed cylinder, three or four feet in diameter and of a length sufficient to provide the desired capacity. Through the center of this cylinder and extending outside of both ends, is a heavy shaft, suitably supported by bearings. Mounted on the shaft, attached to the cast hubs, are a number of specially designed paddles. The shaft is revolved at the necessary speed through a train of gears and pulley from the source of power. The paddles thoroughly mix the lime and water and, by keeping it in motion, prevent burning during the process of slaking. The agitation also prevents too rapid thickening of the Putty or Milk of Lime, as the case may be.

While the slaking lime is still in the mixer, the additional amounts of water are added that trials have proven necessary for the desired product and at the right times. At the proper moment, a gate valve in a pipe line at the discharge end of the mixer is opened and the putty is drawn out and elevated by means of a centrifugal pump to the soaking vats.

Suitable soaking bins, or vats, are

provided, preferably of steel construction, though wood may be used where lumber is cheaper. For putty, the rectangular, open-topped bins are best. These are placed seven or eight feet above the ground and made to hold from 125 to 200 cubic feet of putty. Enough units are provided to allow from two to four days soaking, as the trade may require.

In pumping the putty into these vats, valves from the pipe line over the vats are placed for each vat and the putty discharges on to rather fine-meshed screens. The core and also slow-slaking lime will be mostly retained on the screen. Ample surface is allowed so the screens will not plug too rapidly. Also, they are easily removable for cleaning out after filling a vat. The front, or roadway side, of each vat has a door in it, hinged at the bottom, so it may be allowed to drop down over the side of the box of a truck or wagon and act as a slide or chute, through which the putty, after properly ageing, may be shoveled or pushed for delivery to the job.

The bins for soaking the thinner putty, or Milk of Lime, are made rather deep and have a capacity of from 15 to 30 cubic yards of putty, depending on the size of the installation being made. Each bin has in it, about 18 inches above its bottom and so placed as to agitate a space about three feet wide and the length of the bin, two parallel shafts rotated by gears and a clutch pulley from the line shaft. On these shafts are placed a number of paddles resembling the blades of a boat propeller.

The Milk of Lime is pumped from the mixer in the same manner as the putty, rather coarser screens being provided than for the putty, however. During the soaking period, every day, or oftener if found desirable, the shafts are rotated for a short time and the contents of the bins kept of uniform consistency by the thorough agitation thus provided. When removing the putty, a valve in the bottom of the bin is opened and it flows into a screw conveyor beneath, which carries it to the mixing floor.

The bottom of the soaking bins are kept ten or twelve feet above the ground, in order to eliminate the necessity of re-elevating the putty to mix it. The putty is run into a measuring hopper. Here also, are provided a sand elevator, sand storage bin, and weighing and measuring hopper and a hair picker and proportioner. The sand, hair and putty are then dumped, together, into a batch mixer for mortar, in correct proportions and thoroughly mixed. The mortar is then dumped into a mortar bin and from there fed, as required, into an elevator for delivery into trucks for hauling to the job. All the material and equipment for a complete erection of a putty plant having a capacity of from 800 to 1,000 cubic feet of putty per day can be loaded in an ordinary railroad car. The plant can thus be moved at will to different locations when desired.

Large Centrifugal Compressors

Air at unusually low pressures will be used by the Nevada Consolidated Copper Company for flotation purposes in milling copper ore. Two sets of motor-driven centrifugal compressors will be used for furnishing this air. The compressors will be of General Electric manufacture and each will consist of a 1,250 horsepower synchronous motor driving a centrifugal blower rated 60,000 cubic feet per minute at 3.4 pounds equivalent sea level rating. At the altitude of the plant air will be delivered at 2½ pound pressure.

These will probably be the largest capacity machines ever made for this pressure, the usual pressure used for this work being in the neighborhood of five pounds. The machines will run at 3,600 r. p. m., the motors being direct connected and built into the blower, forming a complete, self-contained unit. The blowers will be of the single-stage type, occupying very little floor space, each unit requiring a space of but 11½ feet by 9 feet 7 inches. Power for the driving motors will be furnished by General Electric turbine generators, now located in the main power plant.

Relay Axle in New Home

E. W. Bassick and W. R. Bassick, along with E. S. Evans and M. H. Furlaud have been engaged for several years in the development of a new type of final drive for motor trucks and busses which is known to the trade as the Relay axle drive. During the past year, trucks equipped with the Relay axle have been put into commercial use in all classes of service, with the most satisfactory results. These trucks have demonstrated their ability and economy under the most trying conditions. The records made by these vehicles is responsible for wider expansion just announced.

To take care of the expanding business and to further carry on the development of the Relay axle equipped truck, E. W. Bassick and associates have acquired the capital stock of Service Motors, Incorporated. The Service plant at Wabash, Indiana, is of the most modern type of construction, designed and built for the efficient production of motor vehicles. The plant has a floor space of approximately 250,000 square feet, giving a capacity of 10,000 to 12,000 trucks per year.

For the past several years the Relay axle has been manufactured by and in the plant of the Commerce Motor Truck Company of Ypsilanti, Michigan. It is planned to form a new corporation, with headquarters at Wabash, amalgamating the two businesses. The officers and directors of the new corporation will be announced at an early date.

W. R. Bassick, president of the Commerce Motor Truck Company, will be an officer and director of the new corporation and will be actively interested in the new business. M. A. Holmes, who for a number of years was sales manager of the Republic Truck Company, now sales manager of the Commerce Truck Company, will be in charge of sales for the new corporation.

Heil Makes Appointments

The Heil Company announces the following appointments:

The Smith Moore Vehicle Company, Richmond, Virginia, as distributors of Heil tanks, bodies and hoists for the territory of Virginia and the Carolinas. Mr. H. J. Smith is president and general manager.

Six Wheels, Inc., Los Angeles, California, has been appointed distributors for Heil hoists in Southern California. Mr. F. B. Tucker is the general manager.

The Arizona Truck and Tractor Company, Phoenix, Arizona, will distribute Heil products in Arizona. This department being under being under the supervision of Mr. Herbert C. Legg.

The Heil Company has opened a direct branch office for sales, service and stock in Greater New York. The location is admirable for the trucking industry of New York as it is situated at Rawson Street and Queens Blvd., Long Island City, New York. A large stock of hoists, wood steel lined bodies and compartment tanks will be carried as well as a complete stock of service parts for the entire Greater New York territory. Mr. George Kuhlman, who has been branch manager of The Heil Company in Philadelphia since 1922, has been named District Manager for the New York and Philadelphia territories with headquarters in New York. Mr. Batchelder will be the Assistant Manager in the New York territory and Mr. Charles Genther Assistant Manager in charge of the Philadelphia branch.

Mr. R. C. Schultz, who has been connected with The Heil Company branch in Chicago has been appointed Cleveland representatives.

New Incorporations

Glenn-Rock Concrete Products, Inc., Jamesburg, N. J. $50,000. To continue business formerly carried on under name of R. Glenn Davison. Adding sand and gravel washing plant with daily capacity of 200 yds. R. Glenn Davison, Pres.; Samuel L. Good, V. P.; Samuel L. Good, Jr., Sec.-Treas.

Howard Material Co., Afton, Wis. $130,000. Production and sale of sand and gravel. Roy Ketcham, Supt.

Hawkins Marble & Tile Co., Wichita, Kans. $20,000. Texas agent, C. H. Hawkins, Amarillo, Tex.

Colonial Marble Corp., Wilmington, Dela. (Corp. Trust Co. of Amer.). $100,000. Marble, stone.

United Talc & Crayon Co., Glendon, N. C. $100,000. Julius S. Holland, Sec.-Treas.; Abraham Duff.

Bowling Green Marble & Granite Co., Bowling Green, Ohio. $10,000. K. L. Parker.

Minnekahta Marble Corp., Sioux Falls, S. D. $2,500,000. W. V. Lowe, Sioux Falls, S. D.; Carl A. Erickson, Minneapolis, Minn.; M. V. Sibert, W. R. Sieg, D. De La Shelton, all of Waterloo, Iowa. Branch offices at Minneapolis, Minn., and Waterloo, Iowa.

Franklin T. Brodix, Inc., 431 N. Michigan Ave., Chicago, Ill. $10,000. Quarry, mine and deal in stone, marble, granite, and other minerals. F. T. Brodix, Henry Furst, Jr., Clifford P. Smith. Cor., Walter S. Holden, 1120, 112 W. Adams St., Chicago, Ill.

General Cement Products Corp., Magee Bldg., Fourth Ave., Pittsburgh, Pa. $1,000,000. Merger of Henderson Structural Units Co., McKees Rocks, Pa.; Goldie Mfg. Corp., Wilkinsburg, Pa.; National Concrete Block Corp., Woods Run, Pa.; and Cretestone Builders & Supply Co., Castle Shannon, Pa. Robert G. Campbell, Pres.; John E. Crawford, Treas.; C. J. Herzog, V. P. and Mgr. of Prod.; H. R. Loughridge, V. P. and Mgr. of Sales; and Albert Henderson, V. P. and Chief Engineer in charge of research and devleopment.

Peapack Limestone Products Co., Peapack, N. J. $100,000. Alice A. Sprague, Marguerite B. Sprague, Ezra Sprague, all of Peapack. (Attys., Lehlbach, Johnson & Ormond, Newark, N. J.)

Red River Crushed Stone Co., Dover, Del. $200,000. Deal in asphalt, limestone, stone of all kinds. K. B. Lynch, A. L. Raughley, M. S. Cook. (U. S. Corp. Co.)

Mississippi Portland Cement Co., Jackson, Miss. $3,000,000.

James Sand & Gravel Co., Johnsonville, Tenn. $75,000. J. E. James, R. D. Herbert, Don James, T. L. Herbert, Jr., H. H. Horner.

Best Made Marble Corp. $5,000. Marble and stone. W. S. Field, A. Zeirmann, A. Johnson. (Filed by P. I. Schick, 1475 Broadway, Manhattan, N. Y.)

Victor Sand Co., Camden, N. J. $160,000 pfd., $16,000 n.p.v. William J. Dubler, M. L. Dubler, Vernon P. Ward, Camden, N. J. (N. J. Corp. Guarantee & Trust Co., Camden, N. J.)

Fayette Rock Co., Lexington, Ky. $10,000. R. R. Smith, L. Tucker, R. T. Gunn.

A. N. Schoone Marble & Tile Co., Cincinnati, Ohio. $50,000. C. F. Arand, M. F. Arand, Ethel Smith, James J. Benz, J. H. Doyle.

Brocklebank Mfg. Co., Chelsea, Vt. $10,000. To quarry granite, marble, and other stones, and manufacture kindred products. H. N. Mattison, Stanley C. Wilson, William H. Adams, all of Chelsea, Vt.

Indiana Limestone Company of New York, 15 E. 41st St. $25,000. H. C. Hand, S. C. Wood, R. J. Gorman. (Filed by White & Case, 14 Wall St., New York.)

Blue Diamond Co. of Washington. Lime and rock. $2,100,000. (Corp. Trust Co. of America, Wilmington, Dela.)

Taylor-Mesaba Chain

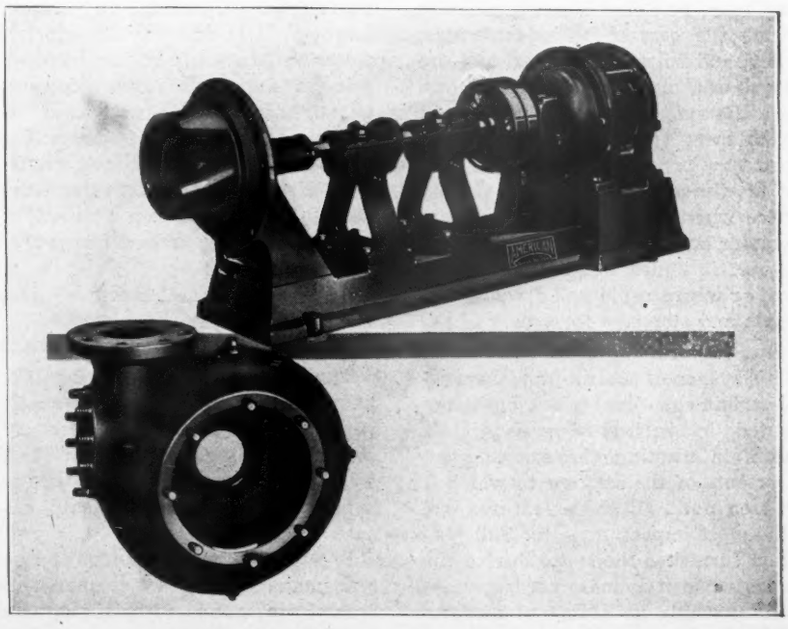
The S. G. Taylor Chain Company has recently issued a circular illustrating styles of the Taylor-Mesaba chain. Four styles are shown: "A" single sling with ring and grab hook; "B" single sling with ring and round hook; "C" single sling with pear shaped end links; and "D" double sling with ring and round hooks. Any length of chain can be furnished in these four styles. The bulletin also includes two useful safe load illustrations and tables. The first gives load values when the angle is decreased between the load and the chain. The second illustrates by means of a table how these constants apply to the Taylor-Mesaba double sling chain. For an example, using a ⅝ chain, the safe loads when the sling is used at 60 degree, 45 degree, 30 degree, 20 degree, 15 degree, 10 degree and 5 degree angles are 15,580, 12,700, 9,000, 6,150, 5,550, 3,200 and 1,500 pounds respectively.

American Centrifugal Pump

The American Well Works has just placed on the market their non-clogging centrifugal pump. The design of this pump marks a new departure in construction and obviates the necessity of screens and their expensive maintenance.

The single blade impeller in the pump is so designed that the stream lines are not separated, but the stream of fluid is kept in one mass and carried throught the pump without being subdivided. By compelling all the liquid and debris to be discharged through a single peripheral passage, there is avoided the possibility of different portions of a single piece of debris being swept into different outlet passages and thereby being hung up within the impeller. This precludes screening fluid containing other material before pumping.

Fluids containing stringy matter, mineral matter, mud, chips, sand, sludge, etc., can be handled successfully. This pump is made in both vertical and horizontal types, and is adapted for municipal sewage and general industrial use.

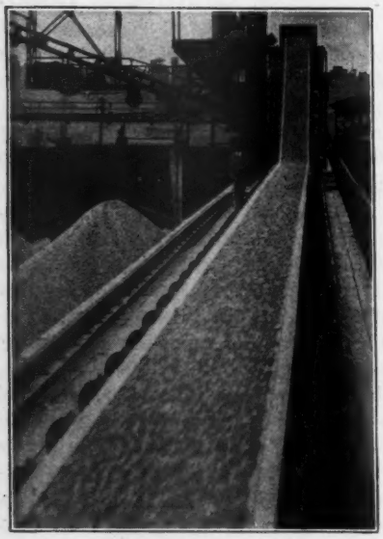


Non-Clogging Centrifugal Pump

Advanced Conveyor Practice

The year of 1926 has marked advancements in belt conveyor designs and construction. Correctly designed and well built belt conveyor installations are now being built to operate over greater distances at higher speeds and carrying larger capacities with new economy standards.

The Stephens-Adamson Manufacturing Company has designed and developed its anti friction pressure lubricated carriers to meet these conditions which they are doing with success.



A Stephens-Adamson Conveying Unit

The T Control system for direct-current motor is described in bulletin GE A-451 recently issued by the General Electric Company. Although the MT (Mill Type) control system was originally developed for use in connection with motors driving steel mill auxiliaries, field has been expanded to include the control of crane bridge, trolley, and hoist motors, coal and ore bridges and many other applications. Since the system can be easily modified to meet special requirements, it fills a very pressing need for the control of direct current motors in any service where it is necessary to start the motor under high or variable loads, and run it under lighter load conditions, or where rapid and frequent reversals and stoppage form part of the duty.

This system of control possesses several striking features which have contributed in various degrees to its success in meeting the exacting requirements of the services to which it has been put. Of these features one of the most important is the full protection furnished the motor during the periods when it is most needed, without diminishing its ability to perform any work required by the normal demands of the service, no matter how severe these may be. In other words, the degree of effort which the motor is permitted to exert is conditioned by the actual needs of the moment and the safety of the motor itself; the safe maximum effort is permitted during starting when the load is heavy, while, during periods of light load, or continuous load operation, the degree of effort put forth is limited in proportion to the demand on the motor.

Another feature of the control that has had considerable influence on its effectiveness is the simplicity, both of the operating principle, and of the various units which make up a complete control equipment. As to the first point, the whole operation hinges upon the principle of magnetic time delay, no complicated system of interlocks or other devices requiring delicate and continual adjustments being necessary to give the requisite timing of the accelerating contactors. As a result, the system is highly reliable and perfectly consistent in its action over long periods of usage. The individual devices that are combined to make up a complete panel are also of the simplest character, and are especially designed to withstand the most severe service conditions. Maintenance is therefore kept to a minimum, since adjustments are seldom necessary. There are no complex parts to wear out, and the parts for all devices are standardized and consequently easily stocked.

Bulletin G E A-548 has also been issued by this company describing a line of pedestal bases for vertical motors. G-E vertical motors are designed with ring bases so that, in the large majority of applications, they may be connected directly to the driven machines without mounting accessories. In some applications, however, it is difficulty to attach the motor satisfactorily to the driven machine and provide convenient access to coupling. This is particularly true in the case of vertical type centrifugal pumps. For such applications, General Electric has available a line of pedestal bases that can be used with both alternating and direct current vertical motors.

Thomas J. Neacy Passes

The Beaver Manufacturing Company, makers of heavy duty gasoline engines, lost its president, Thomas J. Neacy, who died on November 16. Mr. Neacy who was 78 years of age was in good health and his death came as a surprise.

P. S. Neacy, vice-president and general manager of the company, has been elected president by the directors to succeed his father.

New Rock Drill

The Hardsocg Promotion Company has secured a patent on a new rock drill. The main feature of the invention is the detachable bits. The pistons of the drill are actuated by compressed air at the bottom of the cylinder, which can have one or more bits and sockets. Each bit socket is struck independently, at the rate of 2,000 strokes a minute, with an air pressure of 100 pounds and at the same time the main cylinder holding the four smaller cylinders is being rotated from 30 to 100 revolutions a minute. When the bits become dull they are easily knocked out and replaced with sharp drills.

Briefly, this rock drill consists of a drill bar, and a plurality of removable cutter bits arranged at the lower end of the bar. These bits are formed with a horizontal cutting edge at the bottom and a vertical cutting edge at the side and having enlarged vertically extending portions inwardly from the cutting edges. These portions fit into corresponding recesses in the lower part of the drill bar, thus holding the bits in position with their bottom cutting edges converging in the proper matching relation.

This company is prepared to furnish these drills to drill holes four inches in diameter, 100 feet deep, which will have one piston striking one socket with four sockets. Another type has two pistons each, striking a socket with one bit in each socket that will drill from five to five and a half inch holes 100 feet deep. Yet another type has four pistons, each piston striking a socket having four pistons, each piston striking a socket having a bit in each socket which will drill six to six and a half inch holes 100 feet deep, the cylinders being rotated as previously described. These drills are designed for blasting in pits and quarries.

Pittsburgh Steel Drum Plant Greatly Enlarged

The Pittsburgh Steel Drum Company has enlarged its plant during the past year by adding about 8,000 square feet of floor space and several additional machines. At the present time an additional building approximately 4,000 square feet, is under construction. This building is for use as a machine shop and warehouse for dies. The building will be absolutely fire proof which is important for its use as a storeroom for dies. This company expects to place on the market, in a few weeks, a line of small steel containers and the necessary machinery and tools for producing them is now being constructed.

Harnischfeger Excavator Design

Some of the salient features in the design of the P and H excavators, manufactured by the Harnischfeger Corporation are of interest and are described here briefly.

The backbone of the corduroy is a heavy steel casting. No stress, or strain can bend or deflect it. It carries the roller wheels, swiveled for road inequalities, and the drive sprocket and idler sprocket bearings. The drive shaft, idler shaft, and all roller bearings are bronze-bushed and alemite lubricated, keeping wear to a minimum. These bushings are accessible and easily replaceable. Instead of links being worn out, the wear is taken on inexpensive, easily replaceable hardened steel bushings. Breaking P&H links is almost unknown—each single link is strong enough to carry the entire weight of the machine. Breaking the strong main casting is inconceivable.

The carbody is one massive steel casting. On top it carries the swing gear. The carbody casting is so heavy and rigid that the permanently correct alignment of the bearings it provides is assured. Whatever damage may be done to this part of a P&H machine through overloading, abuse, neglect or ordinary wear—the replacement of the broken or worn part brings the machine back to the same condition as new.

The swing gear or slewing rack is a single, one-piece, steel casting. The roller track is machined and the teeth are accurately cut on the outside. Strong heavy spokes radiate from the center which carries a gudgeon or center pin of large size. The swing gear is securely fastened to the carbody casting by many body fitted through-bolts. It thus becomes practically an integral part of and adds greatly to the rigidity of the carbody. The revolving frame consists of a large, single piece, heavily ribbed casting. This provides a rigid base for the engine and for the main and swinging machinery. To this machinery base casting are rigidly bolted the heavy cast steel side frames on which are mounted the drum shafts and engine jack shaft.

New Rock Hog Crusher

The wider use of crushed stone and more exacting classification, has served to create the demand for a machine for economic capacity reduction to inch and one-half and smaller without troublesome returns, splinters or excess of fines. For the past five years the Horton Manufacturing Company have been experimenting with and developing an entirely new crushing principle with the one thought in mind of doing the old job in a better and cheaper way. Toward this end numerous machines embodying this new principle have been built and scrapped, with the result that the finished product as perfected today under the hardest kind of service is offered as a decided step forward in crushing practice.

The principle involved is a combination crusher and attrition action in which the material in passing through the crusher is trapped, crushed and discharged in uniform sizes with a minimum of fines produced. In addition to this application of a new principle numerous refinements of mechanical principles have made for a machine of maximum crushing strength with minimum weight involved.

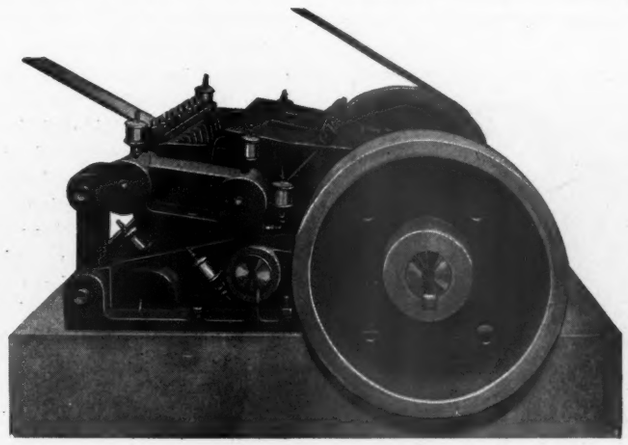
The following structural features of the new machine will serve as an indication of the manner in which the application of this new crushing principle has been put into a finished product that will withstand the hardest usage.

A full floating jaw coupled to a rocking beam by means of four side links imparts such unusual crushing action to the breaker plates that the to and from movement at the point of discharge can be held to a very low minimum. This principle is said to be wholly new in the crushing art. A positive locking feature holds the discharge opening at any desired set. The to and from movement at the point of discharge is very slight.

Unique motion of two crushing members coupled with unapproached crushing ratio averaging nearly twenty to one, obtained through a new application of compound leverages, operate to cut the power consumption by more than one-half.

About seventy-five per cent of the crushing strain is absorbed in four side links, the remainder is distributed throughout the machine so that comparatively little stress is imposed upon the frame or shafting, hence it is possible to keep the frame and shafting relatively light.

Flanges on one breaker plate serve as checks and operate to minimize the total weight of manganese castings required, thus greatly reducing an important item in crushing expense. Plates are reversible and can be removed and replaced in less than thirty minutes. The working parts are interchangeable and accessible. All bearings are protected by an exceptionally efficient lubricating system. The beams are so balanced that no part of their weight is carried on the eccentric.



New Rock Hog Crusher

The Rock Hog, while unrestricted as to the sizes in which it may be manufactured, demonstrates its special worth in reduction work, admittedly the most difficult branch of rock crushing operation. Toward this end it is now offered in two styles and three sizes: 3x36 semi-floating type will reduce from 3 inches to 8 mesh; 4x36 full-floating type will reduce from 3½ inches to ⅜ inch; 7x 36 full-floating type will reduce from 6 inches to ½ inch.

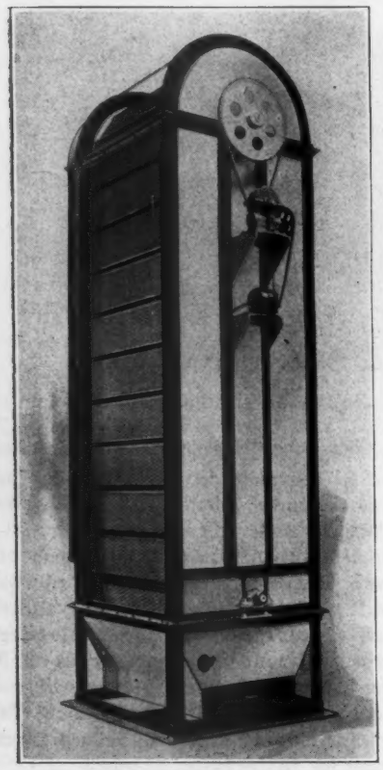
Except for the use of compound leverages which produce a new motion, the utilization of four side links which absorb three-fourths of the crushing strains and the elimination of toggles, heavy liner-cheek plates, etc., it would not be possible to compress so much power and capacity into the weight and space shown in the following table.

Model	Length of Frame	Width of Frame	Total Height	Manganese Steel	Total Weight
3-36 S. F.	35 inches	50 inches	18½ inches	325 pounds	4200 pounds
4-36 F. F.	39 inches	51 inches	17½ inches	358 pounds	3200 pounds
7-36 F. F.	39 inches	51 inches	23½ inches	565 pounds	5200 pounds

Midwest Self-Cleaning Filter

The Midwest self-cleaning filter, manufactured by the Midwest Air Filters, Inc., consists of a sheet metal housing enclosing the filter chain. The top and base part of the machine are standard with an intermediate casing as a separate and interchangeable part. A large outlet opening permits a uniform air velocity through the filter. The filter chain is built up of demountable cells.

The sediment drawer at the bottom of the tank accumulates the dirt, and an oil pump or strainers for the oil is not necessary. The sediment drawer can be conveniently removed and the dirt emptied as desired. Deep tightening chutes are provided around the cells and insure against leaks, which would reduce the cleaning efficiency of the filter. The filter can be bolted directly to a wall or partition being made possible owing to a small duct extending from the housing.



Midwest Self Cleaning Filter

The filter chain is built on the impingement principle embodied in the Midwest standard unit filter, insuring ease of cleaning and making clogging impossible. The cell idea used in these filters has been thoroughly tested and found successful in the field for more than 20 years and this construction, therefore, assures results based on facts already established by many years of operating experience.

A one inch valve has been provided in the tank so that all the comparatively clean oil may be drained off separately. A drain plug, as close as possible to the bottom of the tank serves for draining off the dirty oil before removing the sediment drawer. The complete filter chain is driven by a ¼ h.p. motor with a speed reduction unit and silent chain connection.

Detroit Force Feed Oiler

The Detroit Lubricator Company has recently developed a locomotive force feed oiler known as Model A. This apparatus has been designed to positively lubricate the valves and cylinders of steam locomotives. Its construction has been developed around the idea of combining the maximum of efficiency with the lowest maintenance cost. This has been accomplished through simplicity in design and a reduction in the number of parts to a minimum, by making all parts unusually strong, and by the liberal use of special steels and long wearing materials throughout.

The working parts are self lubricated. The oiler in all its elements is accessible. The pumping mechanism is on the outside of the reservoir, yet it is fully protected against dirt and damage. The ratchet and heater are of unit construction. All these units may thus be easily removed and repaired. The design lends itself to easy installation; there are four mounting connections on the bottom of the reservoir for attaching and the oiler may be located in a variety of places on the locomotive.

These oilers are made in three types, A-2, 2 feed with non-adjustable feeds, A-4, 4 feed with non-adjustable feeds, and A-X-4, 4 feed with 2 adjustable and 2 non-adjustable feeds. All types are furnished with reservoir having 24 pint capacity.

Dodge Power Equipment

A catalog has recently been issued by the Dodge Manufacturing Corporation, "Dodge Power Transmitting Equipment 24 Jr.," being the second edition of this book. This work is very complete in its nature covering all types of units used for the transmission of power such as shafting, couplings, clutches, hangers, bearings, pulleys, etc. The catalog is profusely illustrated with cuts and tables, the latter giving data which is of value to the buyer or man who installs the power transmitting equipment.

This same concern has also published a finely illustrated book "Dodge, a story of big facilities and big jobs" which is interesting in showing not only the large departments in this enormous plant but also some of the larger contracts which it has filled.

Views in the foundry show not only the size but systematic manner in which the moulding work is performed, which is also true of the machine shop. Some of the large units which have been made at this plant are given, two being of especial interest to this field.

The first is part of a complete conveying system supplied to a mining company consisting of over eight hundred rolls equipped with low friction bearings, head and tail pulleys, take-ups, etc.

The second is a scalping screen 13 feet 9 inches long over all with the screen 48 inches in diameter by 9 feet 9½ inches long. The screen was made of 1¼ inch plate with 1¾ inch perforations and rigidly fastened to the heavy cast iron frame.

Northern Conveyors

The Northern Conveyor and Manufacturing Company has recently issued a circular illustrating some of its applications of conveyors. The first is a portable type, 100 foot long, using 24 inch conveying belts, powered with a 4 cylinder Continental gasoline engine. The second is also a portable conveyor equipped with a 30 inch conveying belt and again powered with a 4 cylinder gasoline engine. This conveyor is mounted on a 4 wheel truck so that it can be moved on a railroad track. The bulletin states that this conveyor has proven so successful that a second conveyor was ordered by the user in less than a year. The second unit has a capacity in excess of 300 tons an hour. The boom rests 34 feet from the ground, supported on steel cables. With this conveyor there is a 50 foot over-hang to the conveyor boom at the discharge end yet it balances perfectly at the truck end and is easily moved from place to place. The last two conveyors are used for mixing concrete.

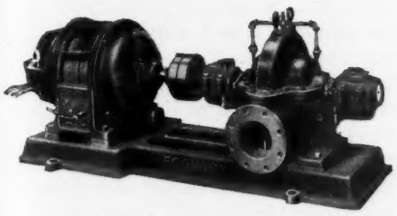
Another conveyor described is a 50 foot drag type and the capacity of this machine is in excess of 200 tons an hour. This company specializes in conveyors and though it manufactures regular standard sizes, in all length, when required any special equipment may be furnished.

Sullivan Sells Channeler

The New Albany Machine Manufacturing Company has purchased the channeler business of the Sullivan Machinery Company. All completed channeling machines, together with stock of parts, patterns, drawings, tools, etc., have been taken over by the New Albany Company who will in the future furnish repair parts as well as complete channeling machines.

Economy Pumps

The Economy Machinery Company manufactures a line of high efficiency pumps which are of interest to quarry owners who require water to be removed from quarries as quickly as possible and with a minimum of power. Other uses for these pumps are for gravel washing, general water supply and the like. The illustration shows one of these pumps designed to handle 1400 gallons per minute against a total discharge head of 100 feet 40.5 horsepower.



National Air Compressor

The compressors made by the National Brake and Electric Company are known as the type "WH" gas engine driven air compressor and are built as an integral unit. With this construction the cylinders of both the air compressor and gasoline engine are mounted on a single crank case. The four engine cylinders and two air cylinders are bolted to this crank case with a one piece crank shaft delivering power to the combined unit. The engines used are vertical, four cylinder, four cycle, valve-in-the-head type with removable heads. Lubrication of the engine is by a combined force feed and controlled splash system. The engine is equipped with a large oil reservoir under the crank case from which oil is pumped under pressure by a gear pump to all main and connecting rod bearings and to pans under connecting rods for splash to cylinder walls and pistons. The cooling system consists of radiator, fan and centrifugal water pump. A thermostatic water temperature control is used to regulate the flow of circulating water through the engine. The air compressor is of the duplex, vertical single acting, single stage type. The air valves are of the thin washer type with three coiled springs per valve with removable phosphor bronze valve seats. All engines are equipped with a maximum speed regulating governor, which prevents the engine running above normal speed. A suitable air receiver is carried horizontally on the rear end of the frame, good for a working pressure of 100 pounds and provided with pressure gauge, safety valve and drain cock. A 20 gallon gasoline tank is mounted on a cradle horizontally above the air receiver. These compressors are built in two sizes of 110 and 160 cubic feet displacements and can be equipped with either iron or rubber tired wheels and with or without spring suspension. They are also furnished ready for mounting on Ford trucks as well as with skids.

Western Ten Yard Dump Car Operated By Electricity

At the Verplanck's Point quarry of the New York Trap Rock Corporation, there is an interesting installation of Western 10-yard one-way side dump cars for quarry use. These cars were made by the Western Wheeled Scraper Company and the Woodford Engineering Company system was used and each car is equipped with 37 h. p. individual motors which take current from a third rail in the track system. A view of one of these cars is shown in the illustration.

Western Dump Car Operated by Electricity

The quarry track is divided into sections, and, except when being spotted, each car is under the control of the operator stationed in a central control tower. The cars are built especially strong for quarry work with steel underframes and beds of 5-inch oak. The trucks are of a special design, considerably heavier and stronger than the regular 10-yard two-way dump car and designed for use with a locomotive. The dumping is air controlled from a source outside the car.

The Western Wheeled Scraper Company has added a new Western rock crusher known as Number 3, with a capacity of 30 to 45 tons per hour with a 2-inch opening, to its products. The crusher has a jaw opening of 11x36 inches. The weight on skids is 16,600 pounds; on wheels, 18,700 pounds, and the floor space required is 92x91 inches.

New Milwaukee Locomotive

Gasoline locomotives are manufactured by the Milwaukee Locomotive Manufacturing Company, and the latest development by this company in the locomotive field is a gasoline locomotive for industrial haulage. This is a 20 ton, 4 speed and known as type H-20.

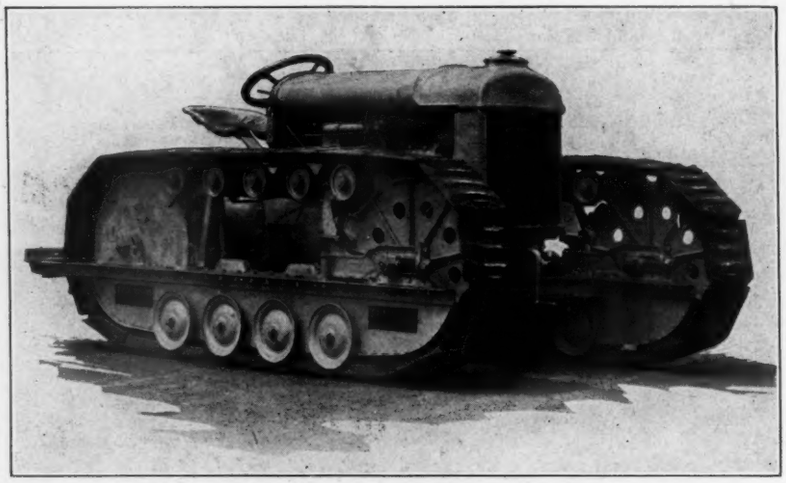
The machine is geared for four speeds of 2, 4, 8 and 12 miles per hour or 3, 6, 12 and 18 miles per hour as specified; at an engine speed of 1,000 r. p. m. The wheel base is 68 inches and length overall with link and pin couplers 233 inches or with M. C. B. couplers 247 inches. With the type of gear transmission used the gears are always in mesh and speed changes are effected by means of jaw clutches. All shafts, gears, jaw clutches and ball bearing operate in a bath of oil.

The clutch used is a Hele-Shaw heavy duty multiple disc type. The hand brake is of the inside spread type, fully equalized and operates on all wheels, the brake shoes being removable. Power to operate the locomotive is obtained from a Beaver model "RY" 6 cylinder, vertical, heavy duty type, 6½ inch bore by 7 inch stroke. Lubrication of the engine is by a force feed system located in the crank case. The power developed at 1,000 r. p. m. is 160 horse power. The engine is fully equipped with carburetor, air cleaner, gas strainer, high tension 2 spark magneto and two gasoline tanks. The approximate weight of the locomotive is 40,000 pounds.

New Trackson Full-Crawler

The new heavy duty model Trackson Full-Crawler for Fordsons, manufactured by the Full-Crawler Company, has successfully completed all tests of its durability and performance, and is now in production.

The new model, which is known as model D, is designed for work where drawbar pull is of prime importance. It does not replace the standard model Trackson Full-Crawler, but is a special machine built for slow, heavy pulling. The model D has been produced to meet the increasing demand for a powerful crawler tractor between the 2 and 5 ton sizes, which will have the pulling power of from 6 to 12 horses, combined with a great track area which will carry the tractor over the most difficult ground conditions, no matter how rough, soft, or slippery.



New Heavy Duty Full Crawler

It is 75 inches wide, 120 inches long, has a rigid frame of great strength, and weighs a total of 4100 pounds. This makes it especially adaptable to use with diggers, hoists, snow plows, and loaders, where great crowding action at low speed is desirable, and where the tractor carries extra weight.

The new model is made of the same high grade electric alloy steel which is used in the standard model Trackson Full-Crawler. Since the power at the drawbar, the ground pressure, and the tractors ability to go through soft or rough ground, depend on the amount of track which is on the ground, the track area of this model has been increased to 1600 square inches. Like the standard model, the model D necessitates no change in the Fordson, and maintains its regular ground clearance. This new model Trackson Full-Crawler, and the standard model will be on display in Booth N. C.-24, at the 1927 Good Roads Show, Chicago, January 10 to 14, Mr. C. W. O'Connor of the Full-Crawler Company, will be incharge of the exhibit.

Bucyrus 1926 Developments

In outlining the contribution of his company during the year of 1926 to the industry of excavation, Mr. G. A. Morison, 2nd vice-president of the Bucyrus Company has given the following outline.

"One of the most outstanding achievements in the industry for this year has been the announcement of a 3-yard full revolving quarry and contractor's shovel, built with all the rugged strength of the old railroad-type shovel and incorporating all the advantages of the small full revolving shovel. This machine, the 100-B, is of the same general design as the well known 120-B; it has the same working ranges and is proportionately as heavy, but it is designed throughout for using a 3-yard dipper in any kind of digging.

"Another announcement of Bucyrus Company has been that of a 1-yard contractor's shovel and dragline, a machine built from caterpillar track to boom sheave to handle a yard dipper. The company has also announced a new 1¼ yard machine which is known as the 41-B.

"A machine of very general interest because of its size and novelty, is the Diesel-electric dipper dredge "Crest" shipped during this year by the company. This machine is not only the largest and most heavily built dipper dredge, but is as far as we know the only full Diesel-electric dipper dredge in use. It was designed for heavy under-water rock excavation and is at present in operation in New York harbor. The main engines of this dredge supplying a total of 1200 horsepower, generate electricity for some 40 electric motors.

"There has recently been announced a 5-yard stripping shovel, known as the 200-B, a machine with a working range somewhat smaller than the largest strippers so generally used in the coal field. This machine, convertible for use either as a dragline or a shovel, has working ranges which admirably suit it to work which does not require the largest machines. It, like the bigger strippers, is available with either caterpillar mounting or truck mounting.

"The company is at present building for delivery about the middle of the year 1927, the world's largest Diesel-electric hydraulic dredge. This machine will be equipped with four 1,150 horsepower Diesel engines with two auxiliary engines of 60 horsepower. The cutterhead is 8 feet in diameter, while the discharge line is 30 inches. Probably the most striking feature of the design of this dredge is that the cutterhead is driven by motors capable of developing 900 horsepower for the period of one hour. This is considerably in excess of the horsepower applied to the cutterhead drive on any other hydraulic dredge for which the information is available. The pump is driven by motor rated at 3,000 horsepower.

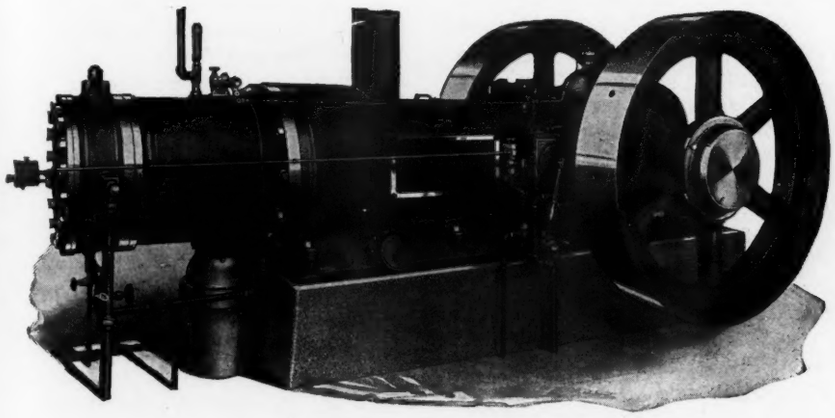
"A rather noteworthy feature of this year's business has been the great sale of electrically driven shovels and draglines. The company has been manufacturing electrically driven excavating machines since the year 1894, but this year's production of machines driven by this power has eclipsed all previous years. We have also had a year which has been marked by a large number of sales of Diesel engine driven equipment. This company originally introduced this type of drive into the field of excavation and this year we have sold more machines of this type of drive than ever before.

"The expansion in the building industry is reflected by the great number of sales of equipment to cement plants and rock quarries. The 120-B and 100-B electric shovels are ideally suitable for quarry work and the 100-B and 50-B electric for cement plants; the great number of Bucyrus machines installed in such plants this year is evidence that this is recognized by such industries.

"The replacement of caterpillar mounting for old railroad trucks under railroad shovels has continued active so that a large proportion of existing railroad shovels are now or about to be so equipped. The gradual return to prosperity on the part of the railroads is reflected in the demand for wrecking cranes and other railroad equipment manufactured by the company."

Primm Engine Improvements

The Power Manufacturing Company, who have been engaged in the development and manufacturing of the Primm oil engine since 1902, have recently announced some improvements in design which have been made during the past year or so. The Primm oil engine is a low compression unit having a compression pressure of 120 pounds per square inch, is of the horizontal type, is equipped with a crosshead, uses both splash and force feed systems of lubrication and is two cycle, surface ignition engine firing once every complete revolution of the crank in the single cylinder type and which does not use the head of compression for starting or ignition.



A Primm Oil Engine

It is interesting to note that in every Primm engine built during the past quarter century, the above mentioned features have been incorporated. There has been no radical change in design in all these years and the present improved type engine is the result of The Power Manufacturing Company's continuous efforts to improve a proven product.

Among several recent developments is included a reduction in fuel consumption. This low fuel consumption is obtained through a combination of features. The first of these is the heat compensation which is a part of the cylinder head as shown in one of the illustrations. The heat compensator is simply a flanged bowl, made of grey iron, the wall of which encircles the inside of the cylinder head wall. The engine is started by means of a hot plug inserted in the top of the cylinder head or by an electric plug which has been perfected within the last year and has proven very satisfactory.

After starting, the hot ring or heat compensator becomes sufficiently hot, through the ignition of the oil, so that it continues as the sole ingnition system of the engine. The fuel injection plug, placed in the center of the cylinder head, is equipped with a nozzle which forces the oil in from six to nine sprays radially against the wall of the heat compensator. This atomized oil, which strikes the large heated surface in a fine vapor, is immediately ignited so that less fuel is required than with a less efficient ignition system.

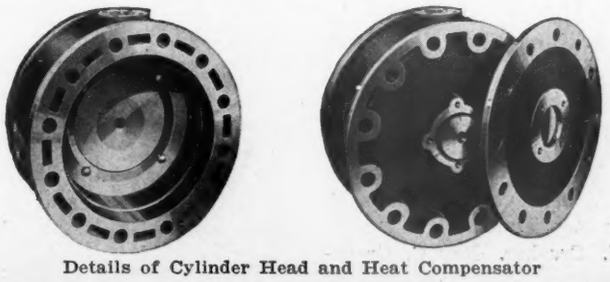
Further, this same heat compensator has an additional use. -As previously stated, it is spaced away from the wall of the cylinder head which is kept cool by the circulating water. If the internal temperatures in the cylinder reach too high a point, the compensating ring will expand with this heat and will then come in contact with the cooling effect of the circulating water in the cylinder head water jacket. This will cause a portion of the heat of the compensator to be carried away by the circulating water and thus the internal temperatures are kept at a proper point. A second reason for lower fuel consumption is that the type SS Primm is equipped with a special type cam operated fuel oil injection pump, mounted in a central control box which also contains the governor, the starting mechanism, etc. The cam operated pump allows quicker injection of the fuel oil and, consequently, enables more of it to be burned and more of its power to be transformed into work.

Another improvement is found in the new type crosshead. This crosshead, as shown in one of the illustrations, is of cast steel and equipped with a babbitted and removable shoe. The crosshead serves the purpose of absorbing the angular thrust of the crank and connecting rod and prevents the egg shaped wear of the cylinder and piston. As the crosshead absorbs this thrust it will naturally wear and this wear comes on the bottom side. The bottom of the crosshead is therefore equipped with a removable shoe which is babbitted on the wearing side. This shoe is easily adjustable by means of shims and therefore it is impossible for the operator to adjust it incorrectly. Considering the fact that many of these engines are in the hands of unskilled operators this is an important improvement as it adds to the fool-proofness of the engine.

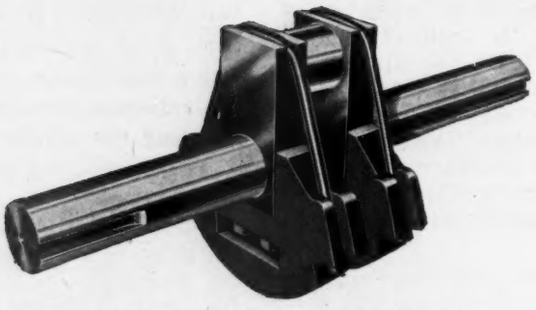
The control box has been designed so that all the control mechanism has been centralized. The improved governor, which gives more perfect regulation, is a part of this control mechanism as is also the fuel pump and the control for the moisture injection valve This valve enables the injection of a small amount of moisture into the cylinder with the scavenging air charge, and aids in combustion and in the control of cylinder temperatures.

In addition to these features, the control box also contains the automatic air starting equipments so that it is only necessary to open a small quick acting gate valve in order to start the engine. The automatic air valve then controls the injection of air into the cylinder so that air is injected only when the piston is ready to start on the power stroke. Fuel oil is injected by the fuel pump at the same time as the air so that starting is practically automatic. When the engine is started, the gate valve is closed and an air compressor, that is a part of the standard installation, compresses the air for the next starting operation.

The present type governor is strong and very sensitive and thoroughly controls the speed of the engine allowing only a 2 per cent variation. One of the features of this governor is



Details of Cylinder Head and Heat Compensator



Detail of Assembled Crank Shaft

that it is not subject to any appreciable load or strain and thus can be depended upon to perform its task properly and continuously.

The crank shafts are constructed with a high factor of safety and the material used has recently been changed from high carbon steel, which is a very good heat treated forged steel, to high manganese steel which is even better and stronger. The change to high manganese is the result of experiments on the part of this company's Engineering department. This crank shaft is shown in an illustration of this article and it will be noted that the crank shaft counterbalance weights are now secured to the shaft in two satisfactory ways instead of one as in the past. The use of the forged steel tie rods which pass over the web of the crank shaft and are securely fastened to the end of the counter balance weights not only insures perfect fastening of the weights but also further strengthens the shaft.

Recent Patents

The following patents of interest to readers of this journal recently were issued from the United States Patent Office. Copies thereof may be obtained from R. E. Burnham, patent and trade-mark attorney, Continental Trust Building, Washington, D. C., at the rate of 20c each. State number of patent and name of inventor when ordering.

1,606,850. Method of and apparatus for utilizing heat from cement clinkers. William S. Speed, Louisville, Ky., assignor to Louisville Cement Co., same place.

1,607,114. Monolithic concrete building construction. Anthony A. A. Byrd, London, England.

1,607,612. Making concrete foundation-piers and the like. Charles R. Gow, West Roxbury, and Linton Hart, Brookline, Mass., assignors to Charles R. Gow Co., Boston, Mass.

1,607,613. Making concrete foundation-piers. Maxwell M. Upson, Englewood, N. J., assignor to Charles R. Gow Co., Boston, Mass.

1,607,615. Crusher. Roy C. Greenfield, Milwaukee, Wis., assignor to Allis-Chalmers Mfg. Co., same place.

1,607,649. Gyratory crusher. Jacob M. Sholl, Milwaukee, Wis., assignor to Allis-Chalmers Mfg. Co., same place.

1,607,729. Power shovel. Edward J. Doberstein, Chicago, Ill., assignor to Goodman Mfg. Co., same place.

1,607,761. Shaker screen. Raymond B. Klees, Natalie, Pa.

1,607,843. Crusher. Ray C. Newhouse, Chicago, Ill., assignor to Allis-Chalmers Mfg. Co., Milwaukee, Wis.

1,607,852. Power shovel. William W. Sloane, Chicago, Ill., assignor to Goodman Mfg. Co., same place.

1,607,858. Ball mill. John A. Acker, Port Huron, Mich., assignor to Traylor Engineering & Mfg. Co., Allentown, Pa.

1,608,508. Means for operating reciprocating conveyers or screens. Richard S. Jacobsen, Chicago, Ill., assignor to Webster Mfg. Co.

1,608,561. Interchangeable plate for crushing-machines. Gustaf H. Larson, Svedala, Sweden.

1,608,562. Manufacture of building blocks, slabs, floors, ceilings, tiles, and the like. Joseph Melandri, London, England.

1,608,640. Material-screening device. Frank N. Wilson, Webster Groves, Mo.

1,608,831. Automatic control mechanism. Charles F. Ball, Milwaukee, Wis., assignor to Chain Belt Co., same place. (For mixing apparatus).

1,609,025. Method of distributing concrete. Erich H. Lichtenberg, Milwaukee, Wis., assignor to Koehring Co., same place.

1,609,072. Heated concrete-mixing. Walter C. Elze, Forest Hills, N. Y., assignor to Hauck Mfg. Co., Brooklyn, N. Y.

1,609,198. Bar feeder for sand-hoppers. Axel G. J. Rapp, Chicago, Ill., assignor to Link-Belt Co., same place.

1,609,271. Material-handling apparatus and system. Robert H. Beaumont, Radnor, and William E. Hale, Fort Washington, Pa., assignors to R. H. Beaumont Co., Philadelphia, Pa.

1,609,298. Apparatus for pulverizing material. Joseph E. Kennedy, New York, N. Y.

1,609,299. Disintegrating or pulverizing apparatus. Joseph E. Kennedy, New York, N. Y.

1,609,338. Concrete-mixer water-supply means. George E. Webb, Milwaukee, Wis., assignor to Koehring Co., same place.

1,609,372. Power-shovel dipper. Erich H. Lichtenberg, Milwaukee, Wis., assignor to Koehring Co., same place.

1,609,404. Portable rock-asphalt and concrete mixing machine. Harold M. Druce, San Antonio, Tex.

1,609,572. Apparatus for making concrete slabs. James H. Pearson, Bloomfield, Ind., assignor to Concrete Slab Co., same place.

1,609,573. Concrete building construction. Henry M. Priest, Elmira, N. Y., and Robert H. Ford, Alexander L. Greenbaum, and Charles P. Richardson, Chicago, Ill., assignors to said Richardson as trustee.

1,609,594. Gyratory crusher. Harvey S. Anderson, Waterville, Ohio.

1,609,624. Mining-machine. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co., same place.

1,606,481. Neutral refractory cement. William F. Rochow, Pittsburgh, Pa., assignor to Harbison-Walker Refractories Co., same place.

1,606,558. Vibrating screen. Henry Clark, Westminster, London, England, assignor of one-half to Head Wrightson & Co., Ltd., Thornaby-on-Tees, England.

Cleveland Consolidated Corp., Cleveland, Ohio. $250,000. Mining quarrying. (Colonial Charter Co.)

Oregon-Idaho Lime Products Co., Portland, Ore. $1,000,000. C. E. Johnson, G. A. Cayot, A. F. Putman.

G. E. Motorized Power

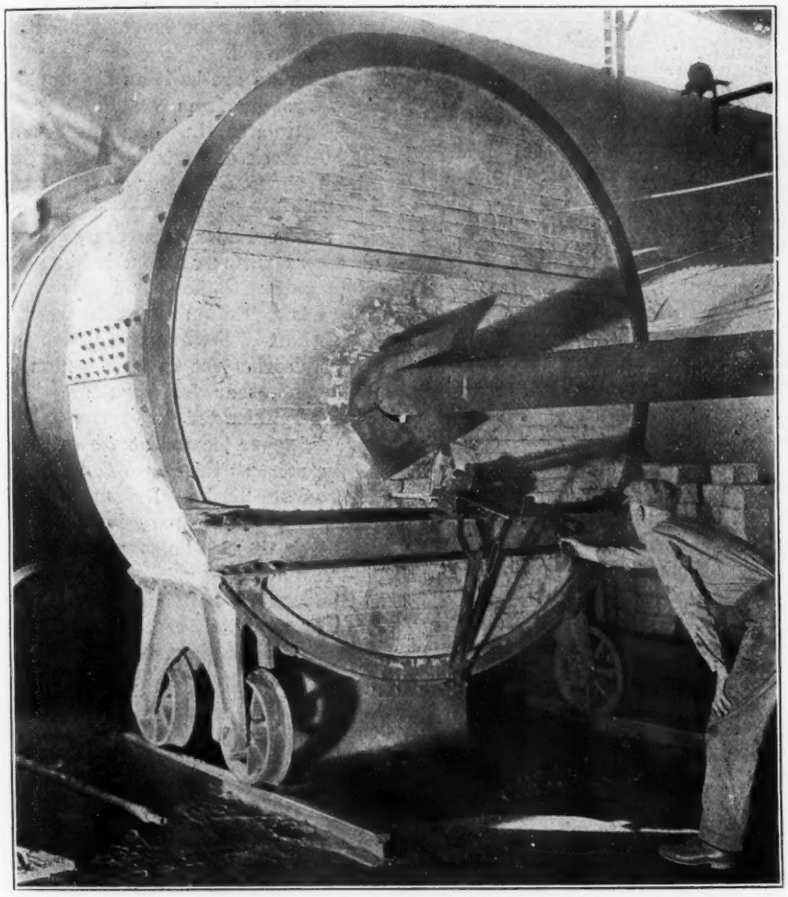
The General Electric Company has recently issued a bulletin GEL—98, Motorized Power, fitted to every use, describing the application of electricity to various commercial purposes.

This booklet includes: G. E. locomotives and some of the plants and services for which it is being used; electric tractors and trucks and how they are being used successfully in reducing costs when handling materials; and the application of electric cranes with several installations.

The section of electricially operated handling devices showing coal and ore bridge, coal tower and cableway, unloader, skip hoist, rotary car dumper, car dumper, portable elevator, scoop conveyor, conveyor belt and portable conveyor is of special interest to this field. The booklet is well prepared, profusely illustrated and contains much valuable and interesting information.

Remington Cement Kiln Gun

During the past year several installations of the Remington cement kiln gun have been effected in various plants and the Remington Arms Company have received very favorable reports of the operation of this special cement kiln gun which they have recently designed and put on the market.



Remington Cement Kiln Gun In Operation

The illustration shows one of these guns mounted and in operation. Cement plants that encounter ring trouble to the extent which requires the shutting down of their kilns frequently, have found that with the aid of this gun it is possible to shoot these rings out instead of having to punch them out. This punching or barring out is a very laborious task which it is desirable to avoid whenever possible as of course it ties the kiln up for quite a few hours, and when this Remington cement kiln gun is used, it is merely necessary to shut off the burner, stop the kiln, and slip the gun into place.

Several of the large cement corporations in the country who have one or more of these guns have forwarded to the Remington Arms Company complete operating data showing that they have been able to keep their kilns in practically continuous use by aid of this gun even though their ring troubles have been very great, and they have also shown that the cost of the ammunition involved, as well as the initial cost of the gun or guns they have been using, has been absorbed completely in a very short while by the saving due to the continuous production ability of their kilns.

The present cement kiln gun cartridge which is used in this Remington gun has been increased in efficiency during the past year by the use of a special propellant powder, and this special powder also has added advantages and its characteristics are such that it is particularly suitable for loading into this type of ammunition which is sometimes exposed to rather adverse conditions of temperature, etc., in the kiln room.

Du Pont Makes Appointments

The Explosives department of E. I. duPont De Nemours and Company has announced the appointment of Mr. J. W. McCoy as assistant general manager of the department, to take effect December 1st. For the past year he has been director of the Manufacturing division of the department. Mr. McCoy is widely known in the explosives manufacturing field. He was for many years engaged in various executive positions at the Repauno plant at Gibbstown, New Jersey, and was finally manager there. Since 1919, he has been engaged in important administrative positions in the Explosives department at the Wilmington office.

Announcement was also made of the appointment of Mr. J. H. Wellford as director of High Explosives manufacture in charge of all high explosives works. This appointment also became effective December 1st. Mr. Wellford has also had a long experience in the Explosives department having been engaged at various plants of the company as chemist and in executive positions. He has been at the Wilmington office since 1922 and during the past year has been assistant director in the Manufacturing devision of the Explosives department.

Mr. H. K. Babbitt has been named as director of Special Products manufacture in charge of the works at Pompton Lakes, New Jersey, and the box and pulp operations in Maine. He was for many years superintendent of the cap works of the Company and for the past year has been at the home office in Wilmington as assistant director of the Manufacturing division in the Explosives department. Mr. C. M. Turner who has been a special assistant in the adminstrative department has been appointed special assistant to Mr. Wellford. Mr. Ralph Assheton who has been handling special work at the home office has been appointed special assistant to Mr. McCoy, and Mr. J. P. Lunsford has been named manager of the Pompton Lakes works in place of Mr. John McIver, who has retired.

Thomas W. S. D. Grates

A circular has been issued by the Thomas Grate Bar Company describing the Thomas W. S. D. Bars. It is claimed that the action of these grates under the fuel bed is unique, resulting in giving great firing efficiencies. Under normal firing conditions it is not necessary to shake the grate violently, but merely to shake them slightly which peels the ash from beneath the fuel bed, without disturbing the fuel bed proper.

All ash and refuse is smoothly cut away, without making any pockets, streaks or seams in the fuel bed. No cold blasts of air rush up through the flues, no more air coming in than is required by the burning feul, and this flow of air is spread uniformly over the entire grate area. The grates are made from semi-steel and owing to their design, which keeps the frame at a low temperature, the danger of burning out is very much reduced and warping is avoided.

Two New Northwest Shovels

Two new shovels manufactured by the Northwest Engineering Company will be shown at the Chicago Road Show for 1927. These machines will be known as Model 2 and 3. The first is built as a shovel with a capacity of ½ cubic yard and is convertible to a ½ cubic yard crane, a ½ cubic yard dragline with a 35 foot boom. The Model 3 is built as a ¾ cubic yard and is convertible to a ¾ cubic yard crane, a ¾ cubic yard dragline on a 35 foot boom. These new developments have been put on the market in answer to the demand for small capacity revolving machines having similar profitable features and embodying the high class of construction maintained in the Northwest models 104 and 105.

New Northwest Shovel

The new models are in every way equal to the models 104 and 105 and have all the Northwest features. Simplicity is at once apparent, and operators like the cleanness of design, no unnecessary shafts, complicated power transmissions, extra drums, compressors, engines, etc. In simplicity lies easy upkeep and long life. There is roominess, strength and endurance in every line. The same materials are used in corresponding parts.

The "feather-touch" clutch control makes operation easy and increases yardage, utilizing the engine to throw heavy clutches, yet retaining the feel of the dipper. Full traction is maintained on both crawlers while turning as well as while going straight ahead; either crawler is slowed down, not blocked. This permits turning to either the right or left with a sure steady movement, free from the jerk and strain that comes where one crawler is blocked or clutches are slipped. Steering is in either direction without backing up, and is accomplished by one man from his seat in the cab. The under part is free from low hung gears and housings. There is ample clearance for high centers or debris. When traveling it is not necessary to line the cab up with the crawlers or to swing the cab to throw steering clutches.

Steering is by one man from a seat in the cab; heavy duty selfaligning ball bearings are used on all high speed shafts, reducing friction loss and eliminating attention to lubrication. The drive from the engine is through helical cut steel gears running in an oil bath and mounted on ball bearings. Rotating and crawler bases are heavy steel castings and all parts are of generous proportion, in keeping with the heavy duty of shovel, crane and dragline service. Convertibility can be made in the field from one type to the other. This is accomplished in the same manner as on the bigger machines, by simply changing booms and without putting in or taking out extra drums or adjusting crowding chains.

The power plant for the model 3 is a Wisconsin motor, having four cylinders with a 5¼ inch stroke and 6½ inch bore. This motor develops 56 horsepower at approximately 900 R. P. M. The power plant for the model 2 is similar but smaller. It also is a Wisconsin and has 4½ inch bore by 5 inch stroke, developing 48 horsepower at approximately 900 R. P. M. Both of these motors are heavy duty in every respect. Bearings are liberal, lubrication is force-feed, oil being forced to both wrist pin and connecting rod bearings by a gear pump. Overhead valves are employed and oil forced to all valve rocker levers through an oil lead. A Bosch high tension magneto with an impulse coupling furnishes the ignition and an air cleaner is provided.

When electric power is desired both models may be provided with electric motors of suitable horsepower. This should only be used where mobility is not a determining factor in profit. For yard or pit work it is highly profitable.

The shovel boom is of the box girder type as used on the larger Northwest shovels. This type has proven its superior resistance to twisting and bending stresses in hard service. The design eliminates wood liners and their attendant bolts, and the constant trouble of keeping them tight.

Mundy Makes New Appointment

The Mundy Sales Corporation announces the appointment of the George W. Kiegler Machinery Company, Pittsburgh, Pennsylvania, as exclusive distributors for Mundy hoisting equipment including the new three speed hoists. This company starts selling Mundy equipment January 1.

Lidgerwood Gasoline Hoists

The Lidgerwood Manufacturing Company has recently issued bulletin 8 describing the Lidgerwood gasoline hoists. These hoists have been developed to meet the demands for a self-contained unit. The hoist designs incorporate a number of features that make them especially adapted for gasoline engine operation. The power plants are mounted on the hoist bedplates, so that the hoists are entirely self contained.

All hoists are built on the duplicate part system from standard gauges and templates, insuring an accurate fit. A stock of parts is kept on hand at all times. The power plant used on these hoists is a gasoline motor of the four cylinder type complete with all accessories and assembled as a complete unit with hood and side covers. There is a friction clutch between the crankshaft of the engine and the shaft which carries the driving pinion, except as otherwise specified. This clutch is operated by a conveniently reached lever located at the same side of the hoist as the levers for the drum friction and brake. By means of this clutch the engine may be allowed to run free of the hoist gearing when starting and idling.

The entire hoist including power plant is mounted on a substantial cast iron bed plate, insuring rigidity and accurate alignment of gearing, shafting and bearings. The drums are of the double cone friction type. The friction woods, which are bolted to the plate wheel gears, have cork inserts and greatly increase the holding power of the friction. When not in operation the drum is loose on the shaft, but a slight end movement along the shaft causes the drum to engage with the friction. This movement is effected by a hand lever operating a friction screw, pin and cross key.

The standard single drum hoists are so designed that additional units can be added if desired. The forward ends of the bed plates are spot faced so that extension pieces carrying the extra drums may be readily bolted on. The additional drum units may be with or without interposed pinions.

The types of hoists illustrated in the bulletin are: Utility hoist, single drum, and with second drum added; Super utility hoist and with second drum added; Single and double friction drum hoists; Double friction drum hoist with boom swinging gear; Three friction drum hoist with boom swinging gear; Steel erector's hoist; Builder's hoist; Concrete tower hoist; Mine hoist; Deck hoists for derrick lighters of the double drum for topping boom, and single drum for one fixed boom and double drum for two fixed booms.

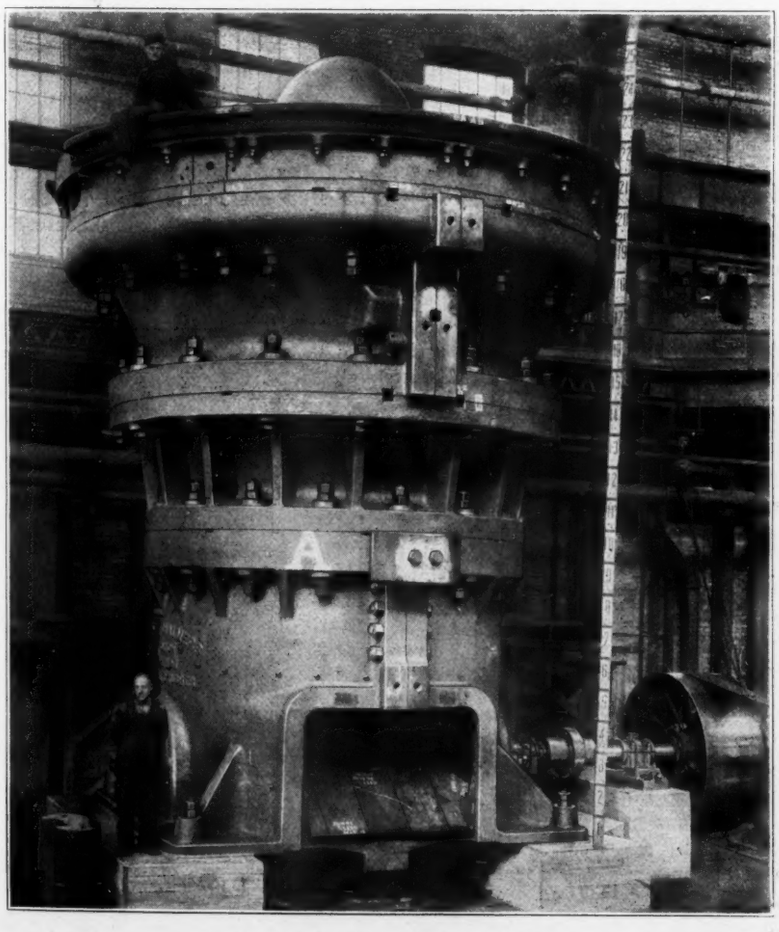
Allis-Chalmers Builds Monster Crushers

The two largest ore crushers ever built are now being shipped from the Allis-Chalmers Manufacturing Company, establishing another world's record for the lines of heavy machinery built by this company. These crushers, weighing a million pounds each, were designed and built for the Chile Exploration Company, a subsidiary of the Anaconda Copper Mining Company for installation at Chuquicamata in the Andes Mountains near Antafogasta, Chile.

On account of the hardness of the copper ore which they must handle, the crushers are of an especially heavy design, built almost entirely of steel, the castings and forging being among the largest ever made in this country. Two hopper openings each 5 feet across, permit a carload of ore weighing 70 tons to be dumped into the crusher at one time. Some pieces of the ore will weigh as much as seven tons. This will be reduced to a 12 inch product; each crusher handling from 2000 to 2500 tons of ore per hour.

Looking in Top of Crusher

The problem of shipping the extremely heavy parts of these machines has been further complicated by the fact that they must be built in sections to facilitate handling in transit and final transportation in the mountains. The largest pieces weigh 60 tons each. Shipment will be made by rail to New York, 25 freight cars being required to handle two crushers and spare parts. At New York, shipment will be loaded on the Chile Exploration Company's steamer, Chilcop, which is especially equipped with heavy derricks for handling this machinery. Proceeding by way of the Panama Canal, the shipment will follow the west coast of South America to Mejillones, a port near Antafogasta, where owing to the lack of harbor on the Chilean coast, the machinery must be transferred to lighters, towed in to shore, pulled on the beach and transferred to cars on a 30 inch narrow gauge railroad. Over this narrow gauge mountain railroad the shipment will be carried to the mine at an altitude of 9500 feet, or more than one and three-quarters miles above sea level. The narrow gauge railroad, steep grades and sharp curves, together with the heavy pieces to be transported, have necessitated the building of special cars to handle these machines.

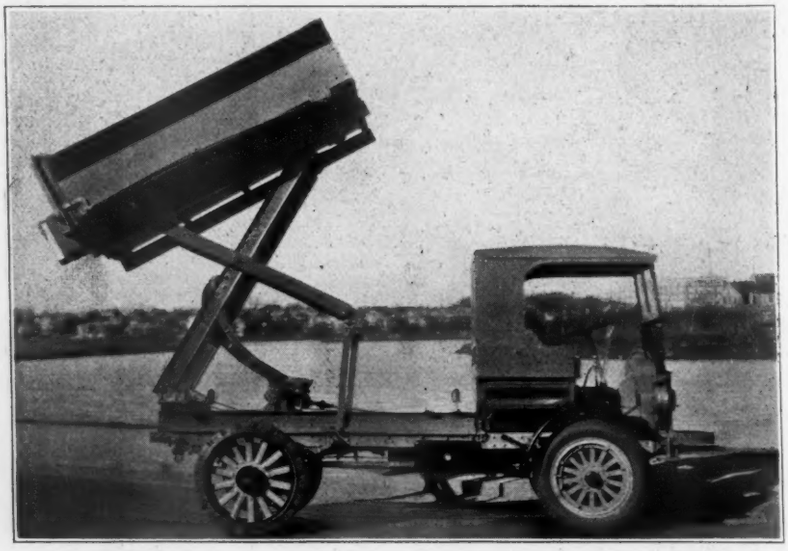


Largest Ore Crusher Ever Built

In the design of these huge machines which are of the Allis-Chalmers Superior McCully Gyratory type, the engineers were not only confronted with the problem of designing the largest machines of this type ever built, for the most severe service, but had also to take into account the question of shipping them over five thousand miles under the most unusual conditions.

New Wood Hydraulic Unit

The Wood Hydraulic Hoist and Body Company recently announced the production of a new Mechanical Hi-Lift outfit. Two capacities of Hi-Lift outfits are furnished. One, of 3 tons capacity, suitable for use on 1½ to 2 ton trucks and a larger of 6 tons capacity for 2½ to 5 ton chassis. The weight of load carried in each case being dependent on the capacity of body used.



Wood Hydraulic Unit

The Hi-Lift action is obtained by using the Wood mechanical hoist wtih the Wood "jack-knife" lifting mechanism, which was first used with Wood hydraulic Hi-Lifts. The members of the lifting mechanism are straight and of amply strong structural steel. The hoist is operated by a two direction power take-off. It can be started, stopped, or reversed, at any elevation by one control lever and stops automatically at the "down" and fully elevated positions. The body is all steel hot riveted. It is equipped with a door and chute in tailgate and a deflector. Telescopic extension chutes are furnished, when desired.

Atlas Powder Developments

The Atlas Powder Company has recently placed on the market a special blaster, Number 2, which is a 10 shot key operated machine. The machine incorporates the dynamo type of generation rather than the magneto principle which was the system previously used. Some of the advantages that this new type of construction makes possible are the following:

Short circuiting the machine at the binding posts has no effect whatever upon the capacity of the machine or upon the strength of the current generated; the efficiency of the machine is not impaired by jolting or jarring; the machine is designed so that the inner mechanism is positively protected from dirt, dust or moisture. It is strongly constructed and built to withstand hard service. It is light in weight, only 4 pounds, 10 ounces, and compact in size, 3¾ by 5¼ inches, and its capacity is 10 thirty foot copper or 10 six foot iron wire electric blasting caps connected in single series.

The new Atlas blasting caps are of the electric detonator of the electric match type, in which the bridge wire is embedded in and supported by the match composition, a moisture proof primer and the bridge wire protected by proper insulation in the form of a fiber tube within the shell.

All parts are rigidly held in place: The capping composition seals and makes moisture proof the entire assembly. The cast composition plug in the fiber tube holds the soldered leg wires to the match head plate and away from the metallic shell, and also holds the match head over the center of the fulminate charge; the match head holds the bridge wire embedded within it and prevents this delicate wire from being broken by any jars the detonator might be subjected to, and the Fulminate charge is pressed solid and is of the most efficient fulminate-clorate mixture.

New Text Book on Welding By Lincoln Company

"Arc Welding, The New Age in Iron and Steel" is the name of a new 160 page text book recently published by The Lincoln Electric Company. This book is devoted largely to the use of arc welding in general production manufacturing. The arc welder is a production tool and this book makes it very evident that a knowledge of arc welding principles must be a part of the equipment of every designer and manufacturer working in iron and steel. The book contains more than 200 illustrations, chiefly of products of representative manufacturers which have been manufactured by arc welding. In addition there are numerous diagrams and charts showing welding speeds and costs.

The book points out that there are two main fields for production welding. The first and perhaps the best known is the use of arc welding in place of riveting. It is demonstrated in this book that a welded joint can be 100 per cent efficient whereas the strength of a single riveted joint can never equal the strength of the members joined. Tank builders were among the first to recognize the greater economy of arc welding over riveting and tday there is probably not a tank shop of any importance that does not use arc welding. Many other products formerly riveted but now arc welded are illustrated and described.

The second main field for arc welding is the substitution of arc welded steel for cast iron. This book makes the claim that 90 per cent of the iron castings now used could be replaced by arc welded steel at a decided saving. There is a complete discussion of how to go about redesigning cast iron for manufacture in steel and the illustrations show clearly where this is being done commercially by representative manufacturers.

The opening chapter of this treatise discusses the superiority of steel over cast iron from both the standpoints of strength and economy. The addenda to Chapter I is a technical discussion of this subject with diagrams and references to recognized authorities.

Reconditioned Rails

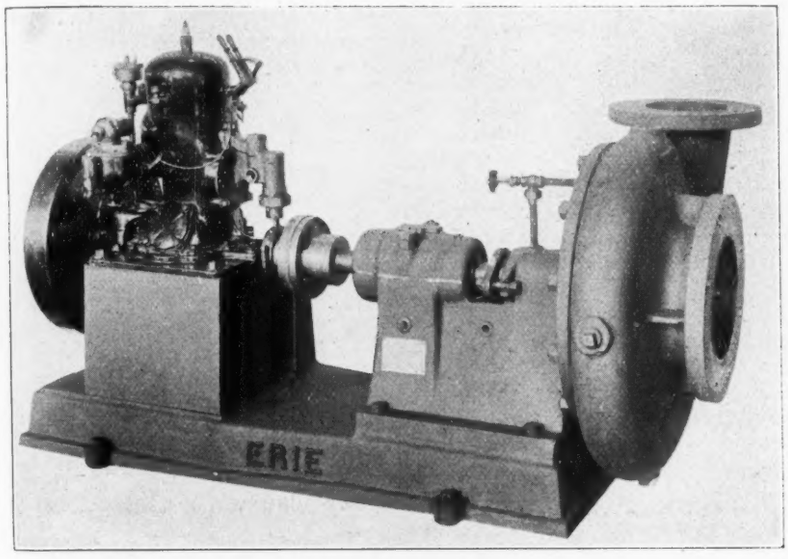
The Walter A. Zelnicker Supply Company have made a specialty of reconditioning rails for twenty-eight years. Rails are brought into their works, thoroughly gone over, sorted, straightened, ends cut off where necessary, redrilled, and when sent out are sent out without the buyer inspecting, on the company's guarantee that the rails will be satisfactory.

Large companies are buying these rails in all weights regularly and at a saving in some instances of 50 per cent. Many companies who formerly would not even consider used rails are now buying this class of rail of which there is a plentiful supply, as against buying new rails. This company also specializes in track accessories of all kinds, both new and used—frogs and switches.

New Erie Pump

The Erie Pump and Engine Works, expect shortly to bring out a new line of general purpose pumps arranged for gasoline engine drive. Single and four cylinder engines will be used on the various sizes of pumps up to four inch discharge.

The illustration represents one of the smaller units. The largest will deliver approximately 500 gallons per minute against 75 feet maximum head. These pumps will serve a wide class of trade, being suitable for dewatering purposes, flushing, jet agitators and contractors' units.



Small Erie Pump

Hill Speed Transformer

The Industrial type speed transformer manufactured by the Hill Clutch Machine and Foundry Company has several interesting advantages and features. This transformer consists of a simple train of spur gears enclosed in an oil tight housing. The spur gears have generated teeth on forged steel machined blanks. It is designed for use wherever a condensed power drive is needed and two speeds required.

Some of the advantages of this machine are as follows: The spur gears operate quietly in an oil bath and step the speed down or up, with great efficiency; high speed motors may be used with this transformer; the speed change can be small or great as desired for practical power transmission; the high and low speed gears are supported by two bearings each, insuring strength and rigidity; the action is positive and the high and low speed shafts with 4 or 8 gears revolve in the same direction, with 6 and 10 gears the rotation is opposite. The transformer occupies little space and can be installed on timber, steel work, concrete or base plate; no adjustments are required and the gear housing is dust and leak proof; it is equipped with an original oil splash system insuring continuous and positive lubrication; and it is also an efficient safety device for the protection of the workmen.

Some features in its design are also worth noting. It is designed compactly with proper allowance for accessibility. The gears and shafting can be easily assembled or removed. The high and low speed shafts and gears may be withdrawn horizontally with their respective housing bearing. Withdrawal of the intermediate shafts allow the intermediate gears to be lifted out vertically, after the housing cover is removed.

The oiling is entirely automatic and is effected by a disc on the high speed shaft. This disc dips in the oil reservoir and distributes the oil thoroughly on all internal surfaces within the housing. Convenient oil pockets and channels are arranged so that a flood of oil covers every moving surface. These tansformers are made in various horsepower sizes, gear units and to produce gear speed reductions or increase to suit almost any necessity or desire.

ARMCO Welded Dredge Pipe

The American Rolling Mill Company has recently issued a booklet "How ARMCO Dredging Products Cut Costs" which describes some of the applications of the ARMCO welded dredge pipe.

In order to eliminate varied or unsound welds and the attending difficulties and delays in the field, this company has adopted the up-to-date and effective method of automatic arc welding in manufacturing the pipes. As is generally known electric welding makes possible a higher temperature. The reason for this is that an electric arc gives a concentrated heat which is confined to a small area. Automatic arc welding assures great freedom from such troubles as holes and cracks in the seams. This means a freedom from leakage or seepage, breaking apart of joints during installation or in service. This is largely possible because the human element has been removed, the welding operation being performed automatically.

This piping has the characteristic good points of light weight welded pipe, low transportation cost, low handling cost and dependable strength. With the close-seam, automatically welded construction, there are no rivets to wear off, no partially open or unsound seams, thus reducing friction or minimizing the necessary driving power for the conveyance of materials. These pipes are made of a special analysis steel which has been developed by metallurgists who are familiar with the requirements of this service.

This company also manufactures pontoon tanks from ARMCO ingot iron. This iron is a practically pure iron with extraordinary rust-resistance and weldability. The value of these two qualities will be apparent when it is remembered that pontoon tanks often remain constantly in water, and depend upon the soundness of their welded seams for retaining buoyancy.

The booklet shows a number of typical illustrations of dredge pipe installations in various industries giving the diameter and length of pipe and work which they perform. A table, giving the safe working loads for various diameters and gauges of pipes is also a valuable asset to the book from an engineering viewpoint.

Elkhart Sand and Gravel Will Erect New Plant

The Elkhart Sand and Gravel Company, of Elkhart Lake, Wisconsin, will erect a complete new washed sand and gravel plant. The method of conveying the materials from the pit to the screen is by belt conveyors. This new plant will produce 25 cars per day of the very best grade sand and stone for building and road construction.

The Bakstad Machinery Company are the construction engineers. Mr. Peter Kramer who is superintendent of plants will supervise building operations.

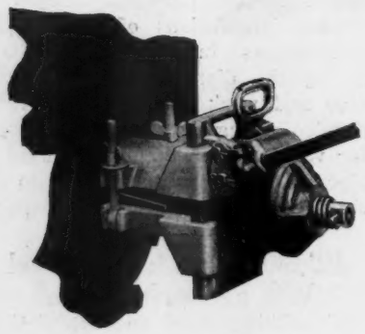
The Russell and Company have recently appointed Mr. R. L. Mead as their representative in Chicago. He is located at number 1340 Old Colony Building.

Duff Pinion Puller and Jack

The Duff Manufacturing Company, after extensive experimenting and study have brought out the Duff pinion puller that is at once simple, quick, safe and positive.

This new, unique tool has been designed for use in repair shops, power houses, mines, mills, in fact any place where motors and gears are used. The puller is constructed of but two parts; the strong, thin-lipped jaws which are clasped over the pinion, and the screw jack section which slides easily into the jaw grooves. When attached the operator turns up the screw, by hand, until it makes contact with the shaft of the motor. A few strokes of the jack lever will bring all parts into extreme tension, a few more strokes and the pinion is pulled without breaking, splitting or damaging the pinion, shaft or armature. An important safety feature is in the fact that the operator stands to the side and clear of the pinion.

The pull of the Duff pinion puller is absolutely uniform around the entire periphery of the pinion and the worm and screw action exerts a tremendous force. No tapping of the end of the screw is necessary. The tool weighs only 50 pounds and is made of highest grade metals; housing and jaws are of case hardened steel, ball bearings used throughout. Three sizes of jaws are available to meet the requirements of various sized pinions.



Duff Pinion Puller

The new Duff governor controlled self-lowering jack is a new development in high-speed jack design. The principle of governor control of lowering speed of lifting jacks is used. The governor absolutely controls the lowering speed and this insures safety under all conditions. The importance of this feature when two or more jacks are used together under loads cannot be overestimated; the jacks will lower the load with uniform speed. The governor makes it impossible for one jack to lower more rapidly than the others, thereby eliminating tipping or uneven lowering of the load. Aside from the mechanical superiority and efficiency, the rated capacities of these jacks are very conservative, with an ample factor of safety.

Hercules Engine

The general design of the Hercules Engine, manufactured by the Hercules Motors Corporation, is one of common sense of engineering or, put a little differently, an effort to get, with the least weight and the minimum external dimensions, the most horsepower. The general design of the full Hercules line, from the "O" to the "TXO" is, broadly speaking, the same. In every case compactness has been assured by the elimination of the superfluous and the substitution of improved simplicity which hold the external dimensions to the minimum. This has been done with no sacrifice with respect to accessibility for routine inspection and the necessity of servicing when necessary. The elimination of the extra overhanging parts has enabled Hercules engineers to produce a high horsepower per cubic inch displacement; and at the same time build a long life motor. There is no better way to emphasize this simplicity than by stating that the Hercules employs about one-third as many parts as many other engines of similar size.

The outstanding features of this motor are: Compactness; rigidity; simplicity and materials. Perhaps one of the greatest sayings in external dimensions is due to the one piece design of the crank-case and cylinder block. The crank-case from the base to the top of the cylinders is a solid, integral one piece making not only for compactness but, for greater rigidity and the elimination of weaving and deflection which causes abnormal wear. To the crank-case is bolted the one-piece oil pan which when removed, makes accessible every connecting rod bearing and main engine journal.

The crank-case being, of course, the real foundation or base of any engine, the simplicity of the one-piece Hercules crank-case and cylinder block goes a long way to insure a resultant dependable simplicity throughout the whole engine. The elimination of the shell bearings is further indicative of adherence to the principle of simplicity. Hercules bearings are babbitted direct into the rods. There is an absolute union between the steel and the bearing metal which, by further radiation of heat, greatly increases the life of the bearing.

Additional evidence of simplicity is obtainable at the removable push rod design. The Hercules cylindrical type push rods can be removed without the necessity of removing the camshaft or front gear cover. The Hercules oiling arrangement differs from the ordinary type of criss-cross drilling in that four individual copper tubes lead direct from the gear pump under force feed to the three main bearings and the front gear compartment. Connecting rod bearings are fed through the crank shaft from the main bearings.

Briefly to summarize, the unusual rigidity of the Hercules is undoubtedly the direct result of a thoroughly compact and simple design. Wherever a useless or superfluous or oversize piece or part could be eliminated or reduced this has been done, and in turn where general practice has included undersized component parts, such as crankshafts, timing gears, etc., the net savings as first explained have permitted the use of the larger parts where necessary and have yet kept the whole of lesser external dimensions and lighter weight, by far, than general practice. Regarding the materials used it is only necessary to say the country's laboratories have been turned toward the determination of the most fitting materials for the several parts of Hercules engines.

New Reduction Gear Designed for Use with Climax Engines

The normal speed of a heavy duty industrial gasoline engine averages around 950-1000 r.p.m., yet many units to be driven must run at speeds decidedly lower than this rate per minute. This reduction in speed may be secured by the use of pulleys of different ratios, or by some mechanical means such as a speed reduction gear set. With the requirements of engine users in mind, the engineering department of the Climax Engineering Company, Clinton, Iowa, have developed a 3½ to 1 reduction gear for use with Climax gasoline engines, models "TU," "R4U" and "R6U."

The newly designed speed reducer consists essentially of a compact set of heat treated, cut gears, enclosed in an oil proof, dust proof housing which is bolted to the flywheel housing of the engine. The high speed shaft and the low speed shaft rotate in the same direction. These gears run in oil and are designed to operate with a minimum of noise. The reduction gear unit embodies a Twin Disc clutch, thus allowing the engine to be started independently of the load. The load is thrown on after the engine is in operation. The driven unit may be connected by flexible coupling or by belt to the power unit.